EMA14

ELECTRICAL MULTIFUNCTION ANALYZER

User Manual

IM 131-U v. 4.1

EMA14 IM131-U v4.1.doc

contrel elettronica srl
I-26900 Lodi - ITALY - Via S. Fereolo, 9
Tel. +39 0371 30207 / 30761 Fax +39 0371 32819
http://www.contrel.it - E-mail: contrel@contrel.it

TERMS OF WARRANTY

The warranty is valid for the period of twelve months after material receipt.
The warranty covers free repair or replacement of equipment parts, which are recognized as faulty due to manufacturing defects.
Warranty does not cover those parts which results defective due to misuse or improper use, incorrect installation or maintenance, operation by unauthorized personnel, damage during transportation, or which in any case do not show manufacturing defects of the equipment.
Not included in the warranty terms are technical interventions regarding equipment installation to electrical systems.
The manufacturer declines any responsibility for eventual injury or damage to persons, animals or things as result of failure to follow the instructions in the user manual or caused by improper use of equipment.
Warranty covers equipment returned ex works.
The expenses of transport as well as the relative risks of same both to and from the place of repair, will be the sole responsibility of the user.
This warranty expires after the date of purchase and any assistance required after said date including spare parts, labour, transport of personnel and material will be charged to the user following the tariffs in force for Technical Assistance Service at the time of such requested service.
In any case the replacement of the equipment as well as the extension of warranty after such breakdown is excluded.

INDEX

1) MAIN INFORMATION

1.1) INTRODUCTION

EMA14 was engineered and tested in compliance with IEC 348 class 1 standards for operating voltages up to 600 Vac rms, considering the VDE 0110 group C isolation standards for operating voltages up to 500 Vac rms.

The present manual contains all of the information warnings that must be followed up by the operator to ensure a right use of the equipment and to maintain the safe operating conditions.

1.2) DESCRIPTION

The EMA14 is an instrument which has been designed to monitor, store and analyze all electrical variable in a distribution line.
All the relevant data are displayed and, if desired, stored on internal RAM and transmitted to a remote PC, via RS485 (standard) on which the compatible management software has been installed.
It is possible to monitor via digital outputs (2 dig. out. standard) alarms, sirens or strategically factory loads.

EMA14 with optional harmonic analyzes can carry out network harmonic content analyzes with FFT method up to the 31st harmonic, very useful to locate network disturbances.

A fundamental feature of EMA14 is the easy way to integrate new additional options and the upgrading of the firmware using serial port and flash technology.

All parameters are showed on 3 rows - 4 digits red LED display (14 segments, 13mm).

Displaying and programming mode are carried out by means of a 5 buttons keyboard.

1.3) CE CONFORMITY AND STANDARDS

The instrument was tested in compliance with EMC 89/336/EEC and complies with the following standards:

EMISSIONS = EN 50081-1 1992 - EN 55022-CLASS B CISPR 22

IMMUNITY = EN 50082-1 (light industry), 1992

SAFETY = EN 61010-2

2) TECHNICAL FEATURES

2.1) GENERAL SPECIFICATIONS

Power supply/Auxiliary voltage
85-265 V 50/60 Hz/dc.
20-60 V 50/60 Hz/dc (option).

Isolation voltage
3700 Vac rms x 1 minute.

Voltage input
3 inputs, range 10-600Vrms between phase-phase.
Over voltage up to 750 Vac permanent, beyond this value it is imperative to use voltage transformers.
Over voltage category: III (fixed installation)
Pollution degree: 2 (normally not conductive; temporary conductive for condensation)
Resistor input: >2 MΩ.
Burden 0.2 VA.

Current input

	Model EMA14	Model EMA14-1A
3 isolated inputs (internal CT) range	10mA-5A rms	4mA-1A rms
Over current max	10A (100A for 1 second)	2A (10A for 1 second)
Burden	0.2 VA	0.04 VA

Consumption
4VA typical.
6VA max, full optional.

Serial output
RS485/RS232 (configurable on board), half duplex isolated, signals Tx/Rx, Gnd.
Programmable baud rate from 1.200 to 19.200 bps.
Protocol: ASCII or Modbus are standard.

Input signals
2 passive opt isolated inputs (1000 V), 12 - 24 Vdc (up to 8, using options).

Output signals
2 photomos outputs, 12-230 Vac-dc / 150mA max (up to 6, using options).
2 , 0-20 or 4-20 mA analog outputs, galvanic insulation (option).

Memory data retention
RAM: 128 KB (useful 50KB); 1 Mbytes (all useful) option.
No volatile memory data using internal battery.
Data retention: 5 years (typical) at +25°C (77°F).
Stored variables: Average power, Min/max values, Harmonics (option), Samples.

Display interface
Red LED 14 segments, 3 rows, 4 digit, 13mm.

Keyboard interface
5 functional keys for paging and programming.

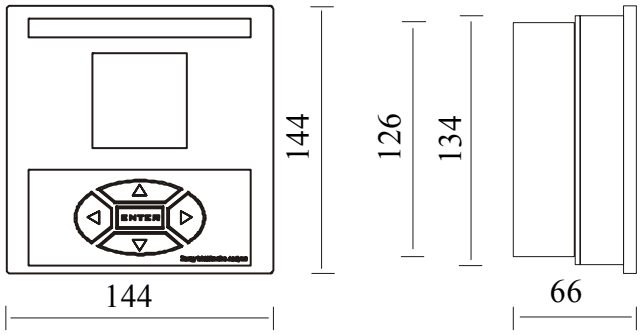
Operating temperature
From -10°C (14°F) to +50°C (122°F).

Storage temperature
From -15°C (5°F) to +70°C (158°F).

Operating humidity
90% not condensing.

Protection standards
IP 52 front (EN60529) - IP65 with gasket (on request).
IP 20 screw and terminals.

Weight and dimension
0,430 kg app. (equipped with 2 digital outputs, 2 digital inputs, RS485 and RS232, Memory 128Kbytes), 144x144x66 mm.



2.2) MEASURING METHOD AND ACCURACY

Measuring range
30-500Hz.

Measuring method
64 sampling per period for V1 and I1, V2 and I2, V3 and I3.
Measuring interval 0,1 second.

Instrument accuracy
Voltage: < 0.5 %
Current: < 0.5 %
Power: < 1 %
Energy: < 1 %
Power Factor: < 1 %

Sampling frequency
45 Hz=2.280 or at 60 Hz = 3,88kHz

Zero self-regulation

Offset
0,1 second.

RTC - REAL TIME CLOCK
Accuracy: 5 PPM

2.3) PROGRAMMABLE PARAMETERS (SETUP SECTION)

Mode, insertion type (4 wires, 3 wires, Aron).
VT and CT ratio.
Integration time of Av. power.
Sampling frequency.
Address or logical number of equipment.
Date and time.
All parameters concerning the input/output section (serial port, analog output, digital input and output).
Preset energy counters.

ONLY USING SERIAL OUTPUT
Time bands of the power consumption in different periods.
Storage section (Min/max, Harmonics, average power and samples).

2.4) MEASURED VARIABLES

PHASE VOLTAGE (Rms)	V_{L1-N} - V_{L2-N} - V_{L3-N}
LINE CURRENT (Rms)	I_{L1} - I_{L2} - I_{L3}
FREQUENCY	F_{L1} (Hz)
TEMPERATURE	T(°C)

2.5) CALCULATED VARIABLES

LINE VOLTAGE (Rms)	V_{L1-L2} - V_{L2-L3} - V_{L3-L1}
THREE-PHASE SYSTEM VOLTAGE (Rms)	V
THREE-PHASE SYSTEM CURRENT (Rms)	I
AVERAGE THREE-PHASE SYSTEM CURRENT	I_{avg}
MAXIMUM AVERAGE THREE-PHASE SYSTEM CURRENT	I_{maxavg}
AVERAGE LINE CURRENT	I_{L1avg}-I_{L2avg}-I_{L3avg}
MAXIMUM AVERAGE LINE CURRENT	$I_{L1maxavg}$ - $I_{L2maxavg}$ - $I_{L3maxavg}$
NEUTRAL CURRENT	I_N
AVERAGE NEUTRAL CURRENT	I_{Navg}
MAXIMUM AVERAGE NEUTRAL CURRENT	$I_{Nmaxavg}$
POWER FACTOR	PF_{L1} - PF_{L2} - PF_{L3}
THREE-PHASE SYSTEM POWER FACTOR	PF
COSφ	$COS\varphi_{L1}$, $COS\varphi_{L2}$, $COS\varphi_{L3}$
THREE-PHASE SYSTEM COSφ	COSφ
APPARENT POWER	S_{L1} - S_{L2} - S_{L3} (VA)
THREE-PHASE SYSTEM APPARENT POWER	S (VA)
ACTIVE POWER	P_{L1} - P_{L2} - P_{L3} (W)
THREE-PHASE SYSTEM ACTIVE POWER	P (W)
REACTIVE POWER	Q_{L1} - Q_{L2} - Q_{L3} (VAr)
THREE-PHASE SYSTEM REACTIVE POWER	Q (VAr)
AVERAGE ACTIVE POWER	P_{AVG} (W)
AVERAGE REACTIVE POWER	Q_{AVG} (VAr)
THREE-PHASE SYSTEM ACTIVE ENERGY	Wh+
THREE-PHASE SYSTEM TRANSFERRED ACTIVE ENERGY	Wh-
THREE-PHASE SYSTEM INDUCTIVE REACTIVE ENERGY	VArh+
THREE-PHASE SYSTEM CAPACITIVE REACTIVE ENERGY	VArh-

Total counters and time bands are available (only via serial communication).

TOTAL HARMONIC DISTORTION - THD (%) CURRENT AND VOLTAGE
HARMONIC ANALYZES (Option and only via serial communication)
Analyzes up to the 31st harmonic of both voltage and current for each phase.
V_{L1-N}, V_{L2-N}, V_{L3-N}; I_{L1}, I_{L2}, I_{L3} (%)

2.6) MEASURING & CALCULATION FORMULAS

Phase Voltage RMS $$V_{LiN} = \sqrt{\frac{\sum_{k=1}^{P} v_{LiN}^2 k}{P}}$$

Line Current RMS $$I_{Li} = \sqrt{\frac{\sum_{k=1}^{P} i_{LiN}^2 k}{P}}$$

Active Power $$W_{Li} = \frac{\sum_{k=1}^{P} v_{LiN} k \cdot i_{Li} k}{P}$$

Reactive Power $$Q_{Li} = \frac{\sum_{k=1}^{P} v_{LiN} k \cdot i_{Li}(k - \Delta)}{P}$$

Appearent Power $$A_{Li} = V_{LiN} \cdot I_{LiN}$$

Cosφ $$\cos\varphi_{Li} = \frac{W_{Li}}{\sqrt{W_{Li}^2 + Q_{Li}^2}}$$

Power Factor $$PF_{Li} = \frac{W_{Li}}{A_{Li}}$$

Active Energy $$Wh_{Li} = \int_0^{\infty} W_{Li} dt$$

Reactive Energy $$Qh_{Li} = \int_0^{\infty} Q_{Li}\,dt$$

Line Voltage $$V_{Lij} = \sqrt{\frac{\sum_{k=1}^{P} v^2_{Lij}k}{P}}$$

3 - Phase Line Voltage $$V3\Phi = \frac{V_{L12} + V_{L23} + V_{L32}}{3}$$

3 - Phase System Current $$I3\Phi = \frac{I_{L1} + I_{L2} + I_{L3}}{3}$$

3 - Phase Active Power $$W3\Phi = W_{L1} + W_{L2} + W_{L3}$$

3 - Phase Reactive Power $$Q3\Phi = Q_{L1} + Q_{L2} + Q_{L3}$$

3 - PhaseAppea rent $$A3\Phi = A_{L1} + A_{L2} + A_{L3}$$

Active Energy $$Wh3\Phi = \int_0^{\infty} Wh3\Phi\,dt$$

Reactive Energy $$Qh_{3\Phi} = \int_0^{\infty} Qh_{3\Phi}\,dt$$

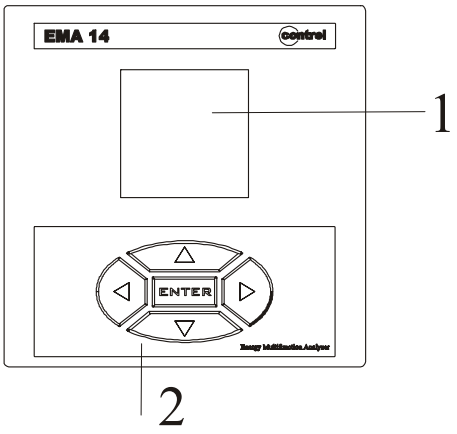
Harmonic analyzes:
Cooley Tukey algorithm.

$$H(k) = \sum_{n=0}^{N-1} h(n)\,\cos\left(\frac{2\,\pi nk}{N}\right) - j\sum_{n=0}^{N-1} h(n)\,\sin\left(\frac{2\,\pi nk}{N}\right)$$

$$for\ \ 0 \le k \le N-1 \qquad N = 64$$

3) INSTRUMENT DESCRIPTION

The front panel of the EMA14 is described on the following section:



1 DISPLAY

Red LED 14 segments, 3 rows x 4 digit, 13mm.

2 KEYBOARD

In the “Acquisition Mode” the "up" and "down" arrows allows to skip through the measuring page of the instrument while in the “Setup Mode” all the buttons including "Enter" key allows to program the instrument.

4) INSTALLATION

4.1) SAFETY

On receipt of the instrument and prior to installation, make sure it is intact and has not been damaged during shipment.
Before installing, make sure the operating voltage and mains voltage are compatible.
The instrument power supply must not be earthed.
The instrument is equipped with a fuse on the power supply type: 5x20mm 315mA 250V Fast (es. Schurter FSF).

- Always disconnect the instrument from all power sources before opening it for maintenance a/or repairs.
- The instrument's capacitor may still be charged even after it has been disconnected from all power sources.
- Maintenance and/or repairs must only be carried out by qualified and authorized personnel.
- If in any doubt about the instrument's safety take it out of service and implement the necessary procedures to prevent its inadvertent use.
- Instrument operation is no longer safe:
  A) when the instrument shows clear signs of damage.
  B) when the instrument does not work.
  C) after long storage in extreme conditions.
  D) after serious damage during shipment.

4.2) OPERATOR SAFETY

Carefully read the following pages before installing and using the purchased instrument.

Maintenance and/or repairs must only be carried out by qualified and authorized personnel.

To ensure proper and safe use of the instrument and its correct maintenance and/or repairs, authorized personnel must follow normal safety procedures at all times.

SYMBOLS

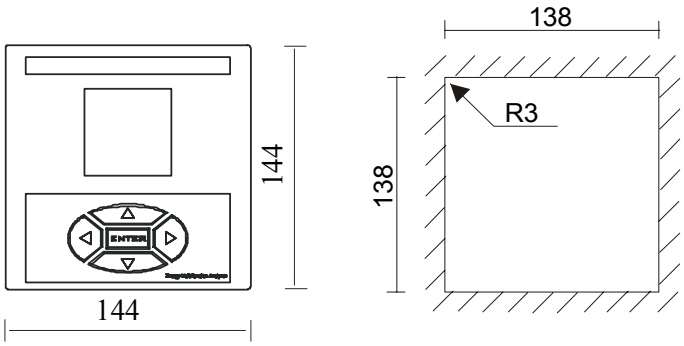
READ CAREFULLY THE CONTAINED INSTRUCTIONS

4.3) MOUNTING

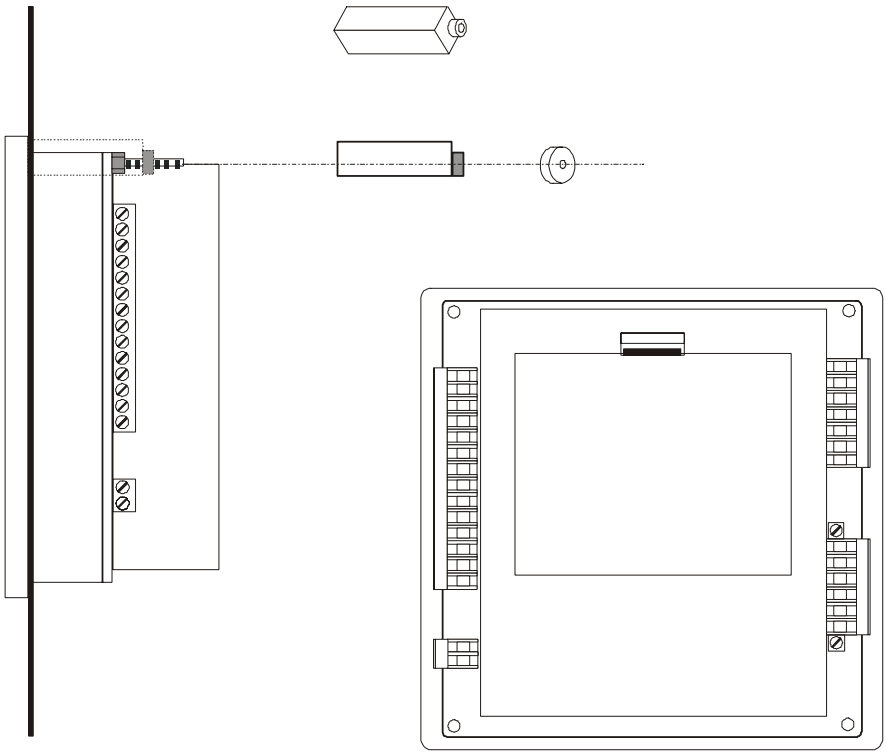
The unit needs to be installed on front panel of mains control/switchboards, wiring and connections must be carried out following the EMC (Electro-Magnetic-Compatibility) procedures.
Plug in screw terminal blocks are used for appropriate wiring. There is a security locking on the current inputs terminal block.

Suggested is to install the equipment on vibration free switchboards and with an environmental temperature ranging between -10 °C and +50°C.

The panel cut-out of the unit is the following:



Following the picture below mentioned, insert the instrument from the front side of the switchboard; from behind insert black support guide on the screw of the instrument, once the black support guide fits on the screw and is pushed against the instrument and the internal panel, screw the nut until the instrument is fixed on the panel.



There are n.4 support guides and n.4 nuts to mount the instrument.

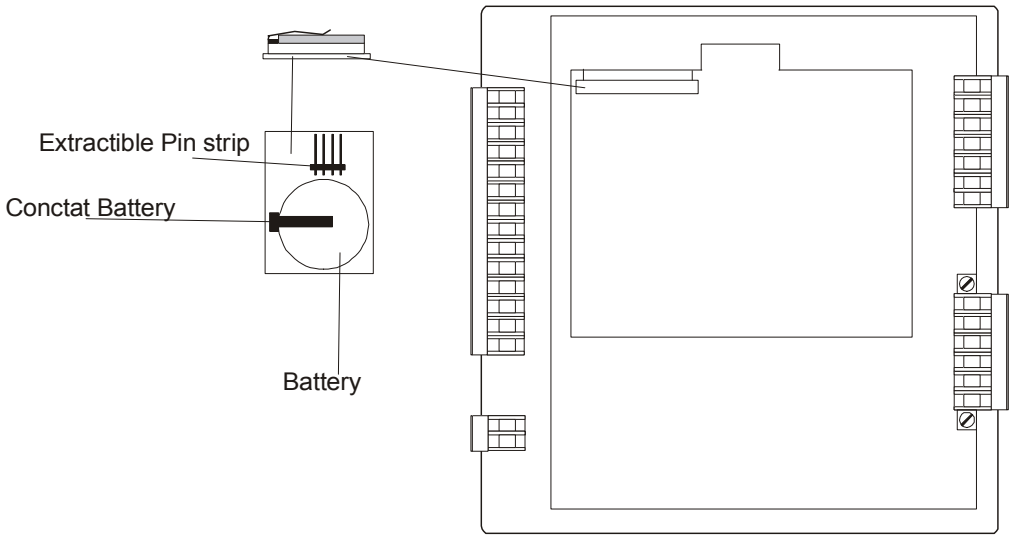
5) INTERNAL BATTERY

To avoid to lose the setup and all storing data, the instrument is equipped of an internal battery (CR2450).

5.1) REPLACEMENT OF THE INTERNAL BATTERY

Only a qualified and authorized technical person can change the internal battery.

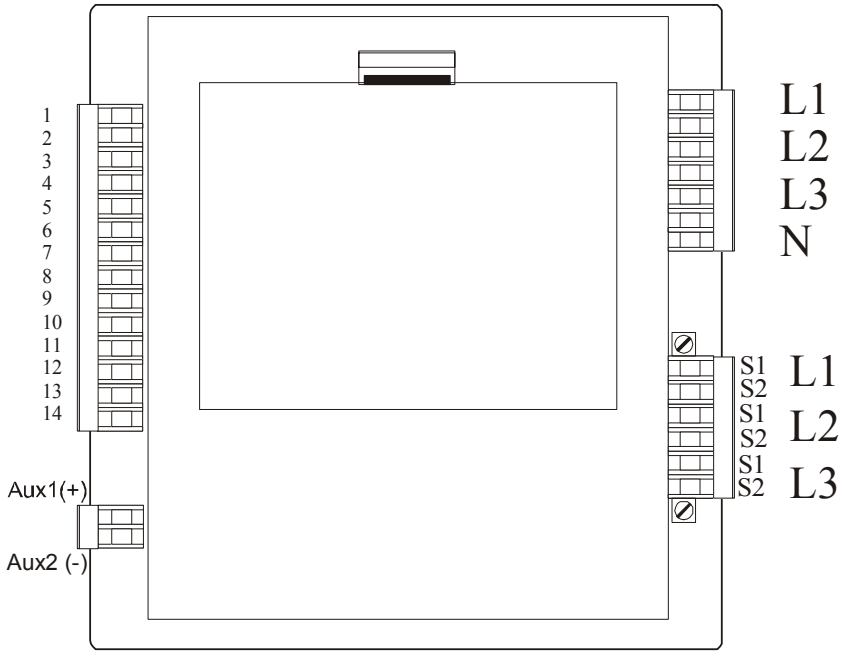
This operation will delete all storing data and it will restore the default setup with the exception of the password and the code to enable the harmonics and time bands. Using the software NRG (or relative serial commands) it's possible to download all storing data to avoid to losing same.
The next figure shows where is located the battery inside the instrument.



Instruction to change the internal battery:

1) It's necessary to cut off the power supply of instrument and to disconnect all inputs and all outputs.
2) Remove the seal from the rear door.
3) Open and remove the rear door.
4) It's necessary to pay attention to presence of residual voltage inside the instrument. Extract the battery circuit without touching any other component.
5) Change the battery. Put the positive pole in the upper direction.
6) Plug in the circuit with the new battery (in the upper directions) inside the instrument. The 4 pin strip must meet with their relative support.
7) Mount the rear door again end close it. Restore all the connection and turn on the instrument.
8) In the Warnings page is possible to check the condition of battery (BATTERY OK).

6) CONNECTION



Connection Table

Connector	Name	Connector	Name
1	TX/A (ser.output)	8	2 Digital Input (+)
2	RX/B (ser.output)	9	2 Digital Input (-)
3	COM (ser.output)	10	
4		11	1 Digital Output A
5		12	1 Digital Output B
6	1 Digital Input (+)	13	2 Digital Output A
7	1 Digital Input (-)	14	2 Digital Output B

6.1) POWER SUPPLY

The instrument doesn't work without power supply.

Before powering the instrument verify always to insert the right value (85-265 Vac/dc standard; 20-60 Vac/dc OPTION).

The instrument is equipped with an internal protection fuse on the power supply, type 5x20mm dimensions, 315mA 250V, Fast (es. Schurter FSF). If the instrument is off, with presence of power supply, it's necessary to verify the internal fuse.
In case of fuse replacement, disconnect the instrument from the power supply, current plus voltage input and all input/output sections (digital input/output, analog output, RS485/RS232 serial port etc.), then open the rear door and change the fuse that is near the power supply connector (in the low part of instrument). Only a qualified and authorized technical person can change the fuse. Extract the interrupted fuse using a screwdriver and with a pliers insert the new fuse.
The instrument's power supply does not require any earth connection.

6.2) VOLTAGE INPUTS

EMA14 can measure voltages up to a maximum 600 Vrms between phase-phase, further that value it is imperative to use voltage transformer. When using voltage transformer, make sure to respect the input and output polarities.

Use cables with maximum cross-section of 2.5mm^2 attach them to the voltage measurement screw terminals.
Connect the instrument following up the wiring diagrams described on chapter 6.4).

EMA14 was developed and tested in accordance with IEC 348 class 1 standards for operating voltages up to 600 Vac rms.

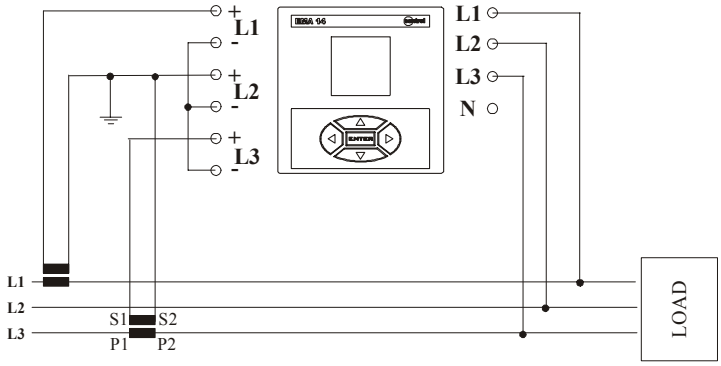
6.3) CURRENT INPUTS

Connect the instrument following up the wiring diagrams described on chapter 6.4).

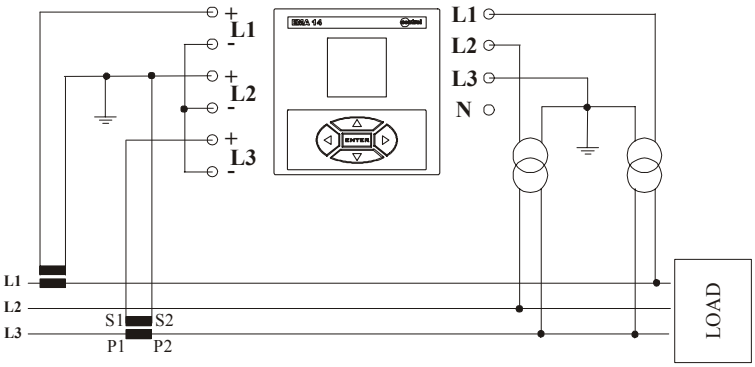
WARNING: before connecting the current inputs to the terminals of the instrument are advised that the maximum allowable current input must be and not exceed 5A.

WARNING: to prevent accidentally disconnection of the current input, EMA14 is equipped with screw able current input, in order to avoid negligence, operator must first shutdown the system and short circuit the secondary wiring of the current transformer, if used, and unscrews the current input terminals.

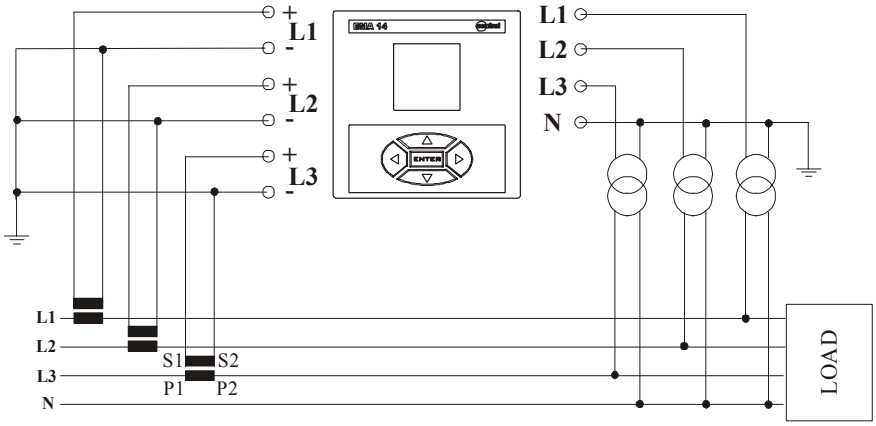
6.4) WIRING DIAGRAMS



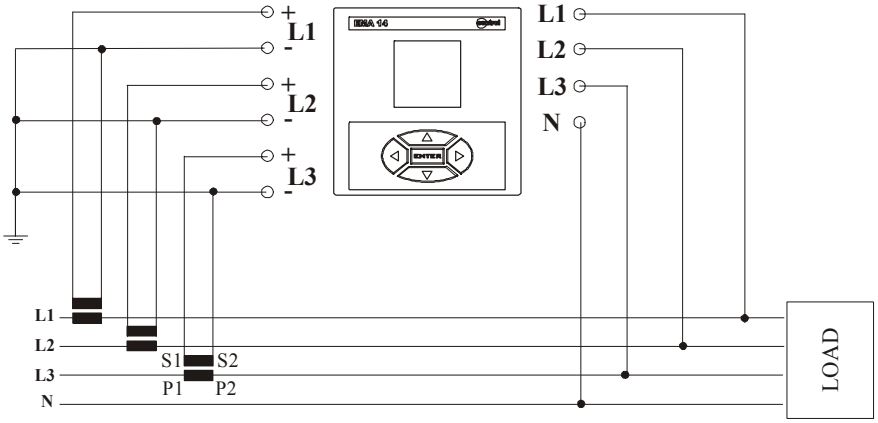
3 wires insertion, 2 current transformers (Aron)



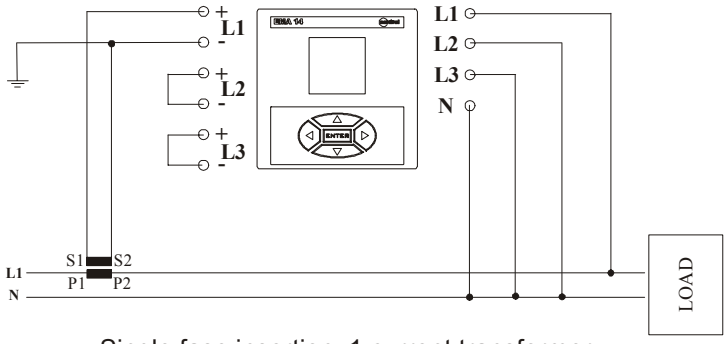
3 wires insertion, 2 current transformers and 2 voltage transformers (Aron)



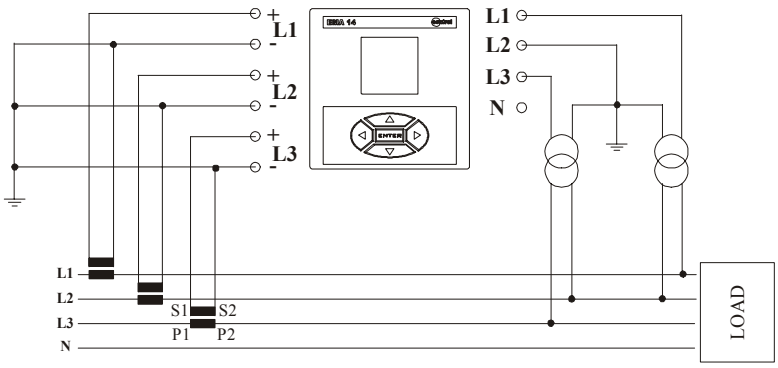
4 wires insertion, 3 current transformers and 3 voltage transformes



4 wires insertion, 3 current transformers



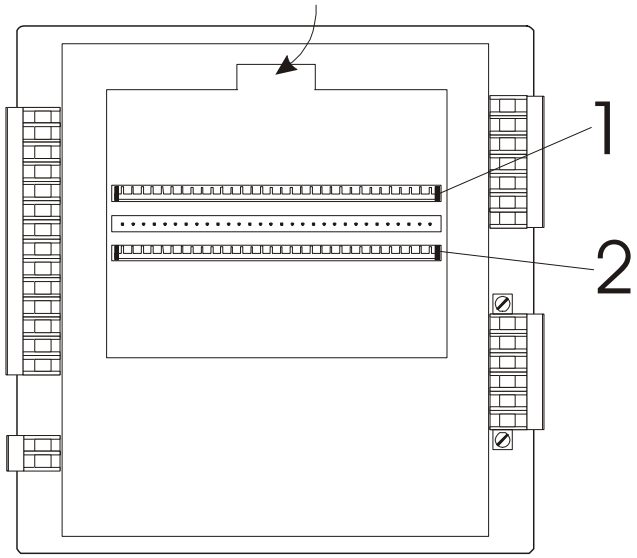
Single fase insertion, 1 current transformer



4 wires insertion, 3 current trnsformers and 2 voltage transformers

7) PLUG-IN MODULE INSERTION

See the following picture to insert the plug-in module:



It's only possible to see the two slots, shown in the picture, when the rear door is removed. To remove the rear door it's necessary to act, in the zone indicated of the arrow, on the retention lever.
The first slot is used to insert the option board of the digital input, digital output, analog output and serial port:

a) 6DI 6 digital inputs
b) 2DI+2DO 2 digital inputs + 2 digital outputs
c) 4DO 4 digital outputs
d) 2AO 2 analog outputs
e) 4AO 4 analog outputs
f) COM2 1 serial port

The second slot is used only for the option memory: MEM Ram (1Mbyte).

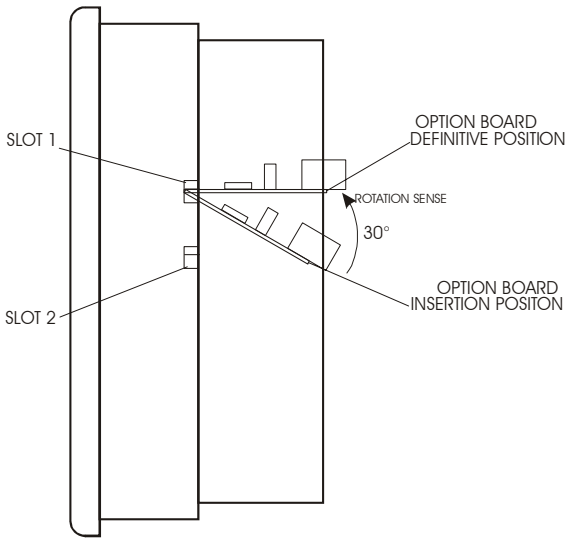
Warning: if you insert the option board in the wrong slot, you can damage the instrument.

Warning: when the option boards are plugged or unplagged the setup is lost and the default backup comes back.

7.1) INSERTION PROCEDURE

Only a qualified and authorized technical person can insert the plug-in module.
Follow this procedure to operate in the maximum security:

1) Cut off the power supply of instrument and disconnect all inputs and all outputs.
2) Remove the seal from the rear door.
3) Open and remove the rear door.
4) It's necessary to proceed with a lot of accuracy, without touching other components, because there are residual voltages.
5) Before starting the operation of insertion of the plug-in module in the slot number 1, it's necessary to remove the plug in terminals block.
6) If you must insert plug-in modules in both slots, it's advisable, but not necessary, to insert before the board on slot number 1 and after the module on slot number 2.
7) Insert with a lot of accuracy the module with an angle of 30° in the down direction respect the slot of insertion and with upper position the component side (see the following picture).
8) Rotate the board in the upright direction until the two hooks hold the board, which should be at the same level of the slot (see the following picture).
9) Close the instrument using the rear door with the hole, in which will enter the plug-in module of the slot number 1. You can use a screwdriver to help you to centre the terminal block with the hole of rear door. It's not necessary to use the rear door with the hole for the memory board of the slot number 2.
10) Replace all connections and turn on the instrument. Check in the relative page that the instrument recognizes the board.



7.2) DISCONNECTION PROCEDURE

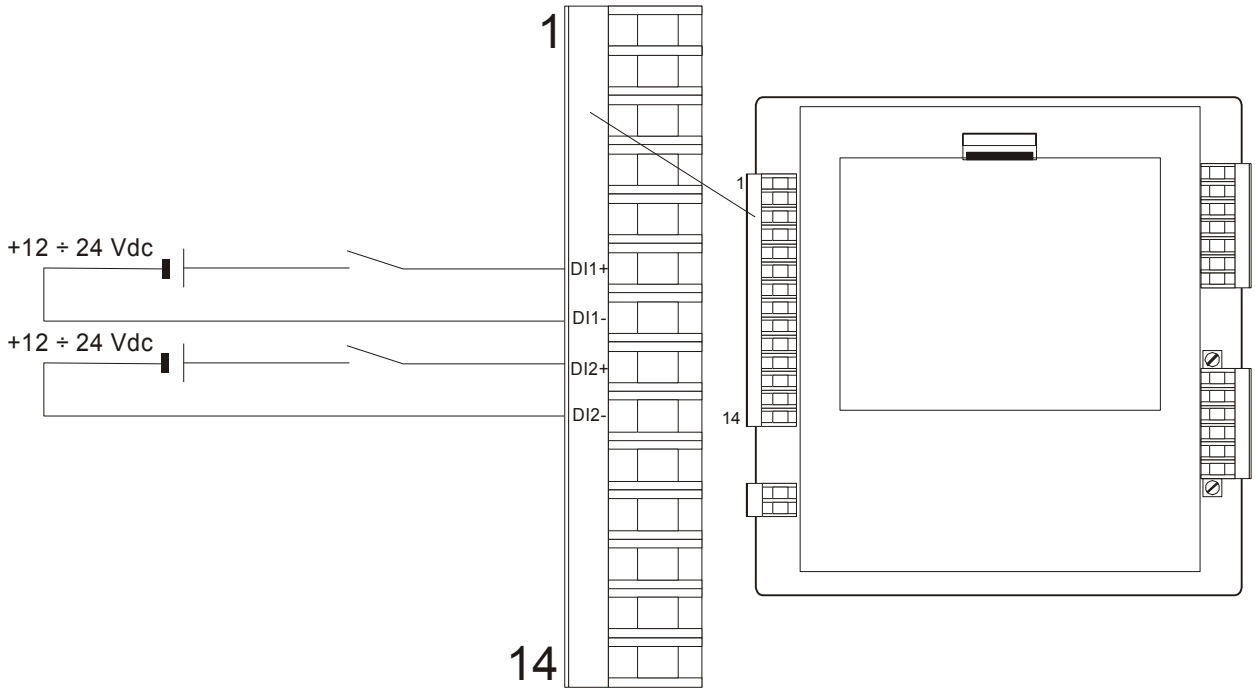
Only a qualified and authorized technical person can insert the plug-in module.
Follow this procedure to operate in the maximum security:

1) Cut off the power supply of instrument and disconnect all inputs and all outputs.
2) Remove the seal from the rear door.
3) Open and remove the rear door.
4) It's necessary to proceed with a lot of accuracy, without touching other components, because there are residual voltages.
5) Push slightly the two hooks, situated on sides, in the external direction using a screwdriver. The module should be disconnected and inclined of 30° in the down direction.
6) Extract the plug-in module.
7) Close the instrument with the rear door.

8) INPUT/ OUTPUT DEVICES

8.1) STANDARD DIGITAL INPUTS

The EMA14 has 2 opt isolated inputs, power supply from 12 to 24Vdc.

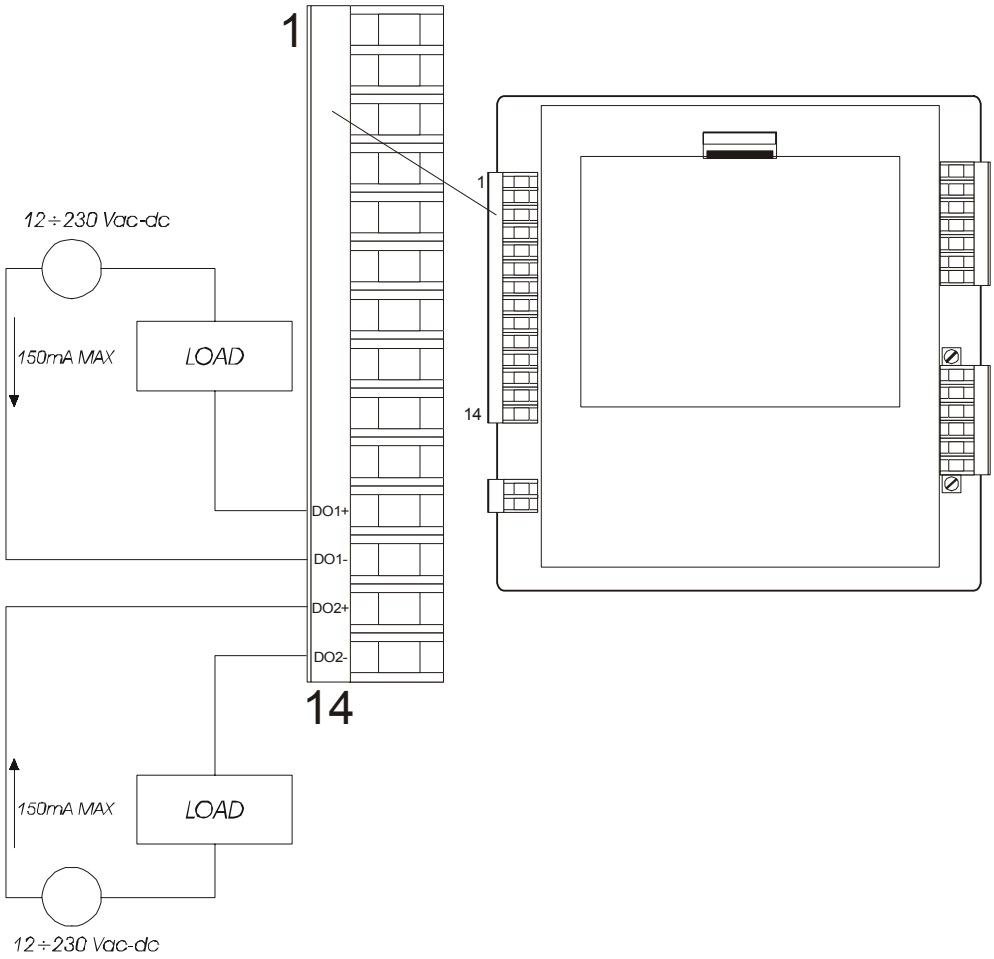


For the digital inputs setup please consult the chapter 11.4).

If long distances must be covered, the wires connected to the EMA14 needs to be wired in a separate channel from the power supply cables, if an intersection occurs between the power supply cable and the analog wires, please remember to cross the intersection at 90 degrees, in order to cut the generated magnetic fields.

8.2) STANDARD DIGITAL OUTPUTS

The schematic of the 2 standard digital outputs PHOTOMOS of EMA14 is represented on the following figure:



Power supply from 12 to 230 Vac-dc, load must not exceed 150mA, typical resistor value of PHOTOMOS outputs, closed contact, is 8Ω (R_{ONmax} = 12Ω). Each output may be programmed by the operator on min/max threshold, external band, always ON or/and pulse output (consult the chapter 11.3).
The signs + and - on outputs in the picture have electric meaningless.

If long distances must be covered, the wires connected to the EMA14 needs to be wired in a separate channel from the power supply cables, if an intersection occurs between the power supply cable and the analog wires, please remember to cross the intersection at 90 degrees, in order to cut the generated magnetic fields.

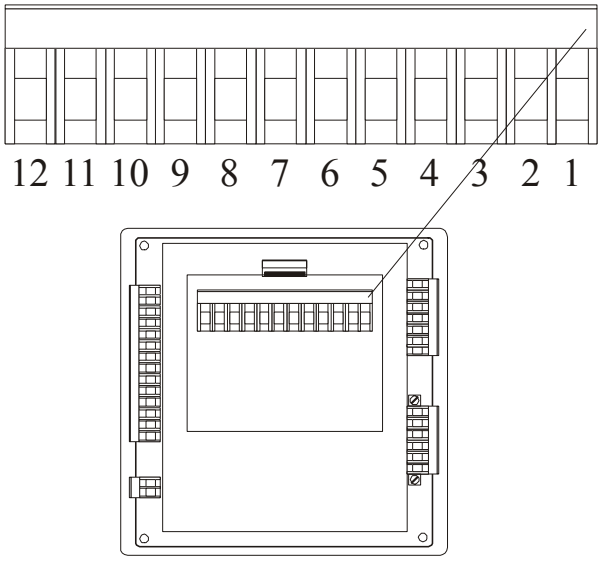
8.3) INPUT / OUTPUT OPTIONS ("PLUG IN" MODULE)

It's possible to use this following plug-in module option:

a) 6 digital inputs (6DI)
b) 2 digital inputs + 2 digital outputs (2DI+2DO)
c) 4 static digital outputs (4DO)
d) 4 relay digital outputs (4DO)
e) 2 analog outputs (2AO)
f) 4 analog outputs (4AO)

Warning. The hardware modification of instrument will change the Setup in the default configuration.

The next picture shows the option board position and the terminal block numeration:



8.3.1) 6 DIGITAL INPUTS OPTION 6DI ("PLUG IN")

After the installation of this optional board the instrument will be equipped with 8 digital inputs (2 standards + 6 optional) and 2 digital outputs. This module has an output 0-12Vcc usable like power supply for digital inputs. The following table shows the pin-out of this plug-in module:

1	**INPUT 3+**
2	**INPUTS 3- and 4-**
3	**INPUT 4+**
4	**INPUT 5+**
5	**INPUTS 5- and 6-**
6	**INPUT 6+**

7	**INPUT 7+**
8	**INPUTS 7- and 8-**
9	**INPUT 8+**
10	
11	**0 Vcc**
12	**+12 Vcc**

8.3.2) 2 DIGITAL INPUTS + 2 DIGITAL OUTPUTS OPTION 2DI+2DO ("PLUG IN")

After the installation of this optional board the instrument will have 4 digital inputs and 4 digital outputs. See in the following table the pin-out of this plug-in module.

1	**OUTPUT 3+**
2	**OUTPUT 3-**
3	
4	**OUTPUT 4+**
5	**OUTPUT 4-**
6	

7	
8	**INPUT 3+**
9	**INPUT 3-**
10	
11	**INPUT 4+**
12	**INPUT 4-**

8.3.3) 4 STATIC DIGITAL OUTPUTS OPTION 4DO ("PLUG IN")

The option has 4 static digital outputs. The instrument will manage 2 digital inputs and 6 digital outputs (all static's). The pin-out is showed in the following table:

1	**OUTPUT 3+**
2	**OUTPUT 3-**
3	
4	**OUTPUT 4+**
5	**OUTPUT 4-**
6	

7	
8	**OUTPUT 5+**
9	**OUTPUT 5-**
10	
11	**OUTPUT 6+**
12	**OUTPUT 6-**

8.3.4) 4 RELAY DIGITAL OUTPUTS OPTION 4DO ("PLUG IN")

The option has 4 relay digital outputs. The instrument will manage 2 digital inputs and 6 digital outputs (2 static and 4 relays). The pin-out is the same of the option before.

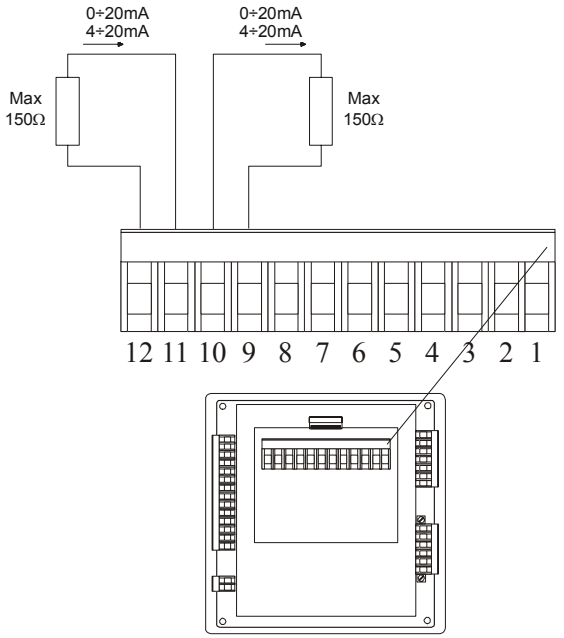
8.3.5) 2 ANALOG OUTPUTS OPTION 2AO ("PLUG IN")

This option will allow to manage 2 digital inputs, 2 digital outputs and 2 analog outputs. See the chapter 11.5), to program (0-20mA or 4-20mA) this outputs. The following table shows the pin-out:

1	
2	
3	
4	
5	
6	

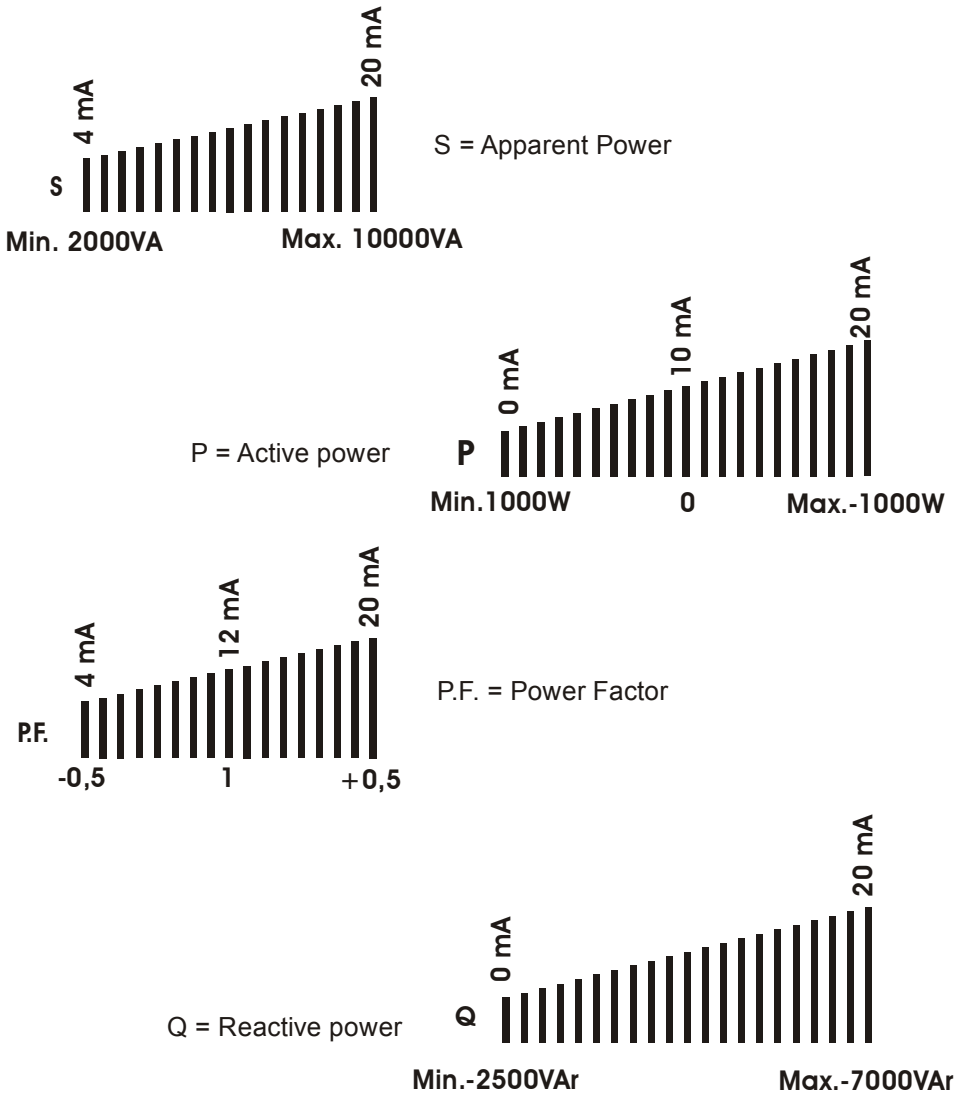
7	
8	
9	**OUTPUT 2-**
10	**OUTPUT 2+**
11	**OUTPUT 1-**
12	**OUTPUT 1+**

Output is at galvanic insulation with maximum load impedance of 150Ω. The connection to other peripherals as recorders, ammeters, remote indicators etc., must be carried out using a maximum cable size of 2.5mm^2.



If long distances must be covered, the wires connected to the EMA14 needs to be wired in a separate channel from the power supply cables, if an intersection occurs between the power supply cable and the analog wires, please remember to cross the intersection at 90 degrees, in order to cut the generated magnetic fields.

The EMA14 gives a current signal (range 4÷20mA or 0÷20mA) proportional to the measures of the selected parameter. The output is bi-directional: the current can be directly or inversely proportional to reference value programmed. Bi-directional means reversal of reference value and not inversion of current.
Examples:



8.3.6) 4 ANALOG OUTPUTS OPTION 4AO ("PLUG IN")

The instrument with this option will manage 2 digital inputs, 2 digital outputs and 4 analog outputs. The pin-out is showed in the following table:

1	
2	
3	
4	
5	**OUTPUT 4-**
6	**OUTPUT 4+**

7	**OUTPUT 3-**
8	**OUTPUT 3+**
9	**OUTPUT 2-**
10	**OUTPUT 2+**
11	**OUTPUT 1-**
12	**OUTPUT 1+**

Information of the connection and example of management of the outputs are explained in the previous paragraph.

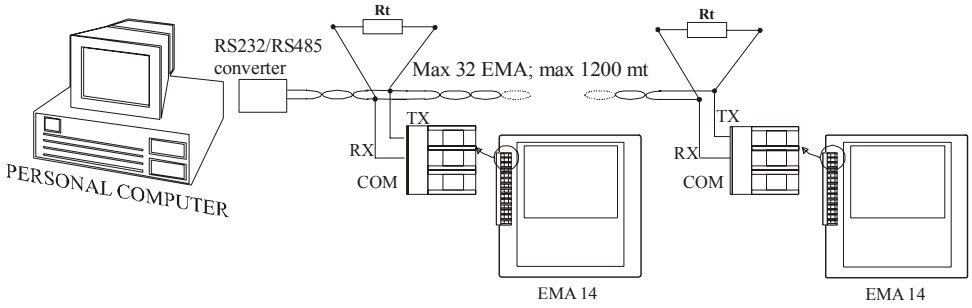
8.4) SERIAL OUTPUTS

Through the combination of an asynchronous serial RS485 and RS232 communication line it is possible to exchange information between the instrument and PC, PLC or other compatible systems. All transmitted characters are in ASCII (American Standard Code for Information Interchange) format.
RS485 allows a multi-drop connection, in order to link-up several instruments on the same network, on the other hand RS232 allows a single point connection.
This last connection must be carried out when both systems are turned off and disconnected from the power line, in order to avoid damages on the serial output.
RS232 may be 9 or 25 pin connection, please follow up the enclosed table:

Signal	Description	DB9	DB25	EMA14
DCD	Data Carrier Detect	1	8	
RX	Receive Data	2	3	2
TX	Transmit Data	3	2	1
DTR	Data Terminal Ready	4	20	
GND	Signal GrouND	5	7	3
DSR	Data Set Ready	6	6	
RTS	Request To Send	7	4	
CTS	Clear To Send	8	5	
RI	Ring Indicator	9	22	

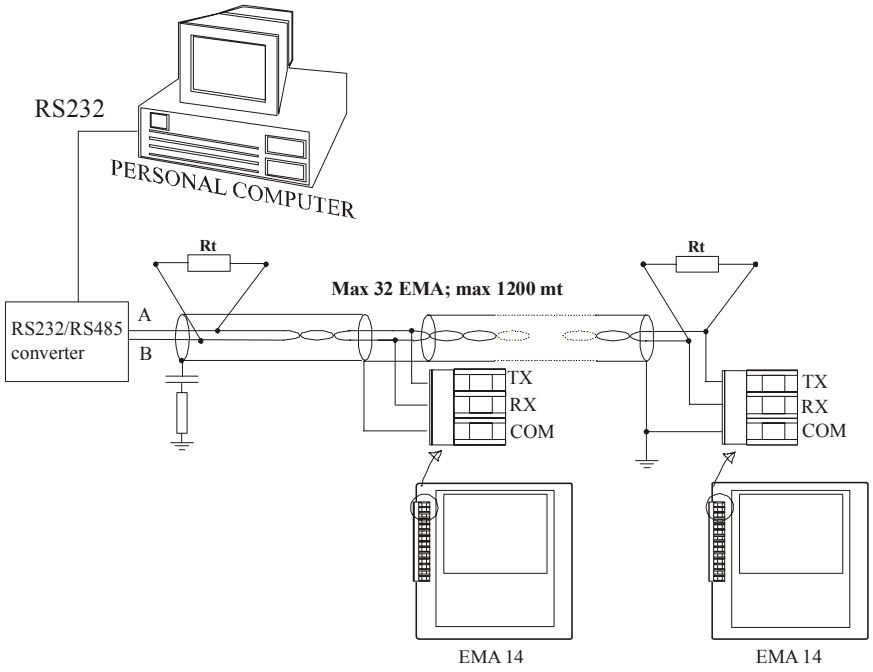
The maximum suggested length of a RS 485 connection is about 1200 mt., while for a RS232 connection about 5 mt.
For longer distances, cables with low attenuation, or connection to line amplifier are recommended.
Up to maximum 32 units can be wired on the same serial line (RS485), exceeding this number it is imperative to insert a signal repeater, each repeater can manage up to 32 instruments.
The polling time is directly proportional to the instruments number connected on the same serial line.

8.4.1) RS485 CONNECTION NOT SHIELDED



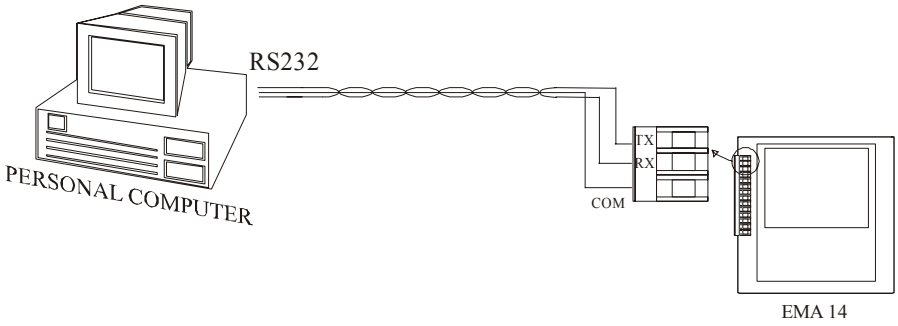
Once a RS485 network has been configured; to communicate between the Host (computer) and the instrument(s) (EMA) a serial interface converter must be wired between PC and instrument(s) as mentioned on the above picture.
In serial line over 500 mt, connect a line termination resistor (Rt=100Ω - 120Ω) between the two twisted pair cables leading from the converter at the end of the network (last connected instrument).
It's recommended to use always twisted pair cable with minimum cross-section of 0.36mm^2 (22AWG) and capacity less than 60 pF/m (i.e. BELDEN cable type EIA RS485-Ref.3105A).

8.4.2) RS485 CONNECTION SHIELDED



Although the signal is given by the difference between A and B voltage, a ground connection is needed to eliminate or to reduce the common mode noise induced (into the bus).
To reduce the EMI interferences need to connect the shield directly to a ground at one end and with a series RC network at the other end.
R = 100Ω C = 33µF.
The max length of the stubs is 20cm.

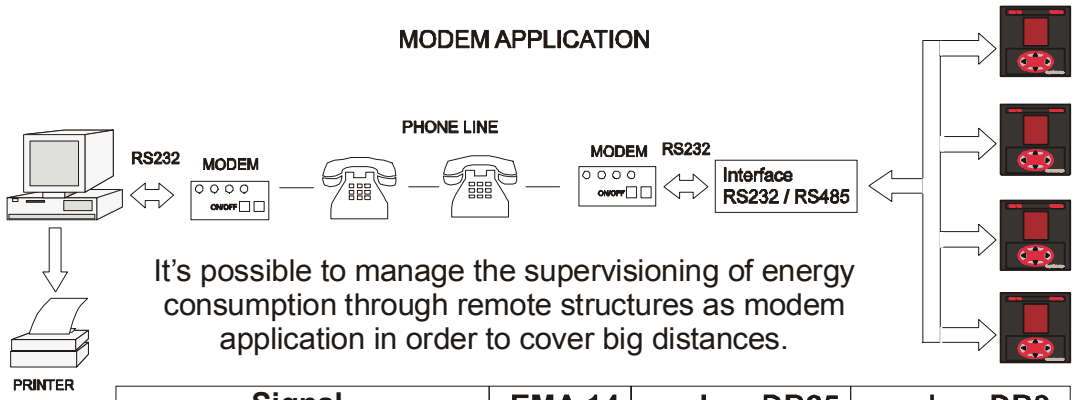
8.4.3) RS232 CONNECTION



If a RS232 communication line is shorter of 5 mt. and a multidrop network will not use, it's not necessary to use a serial line converter because the serial output is compatible with the PC., as shown on the above mentioned picture.
A RS232 could reach 15mt. but the presence of noises in the industrial application could cause breakdown in the communication.
The connection from EMA serial port RS232 to PC RS232 serial port is a PTP, Pin To Pin, connection.

SIGNAL	EMA14	DB9 (PC)
TX	1	PIN 2
RX	2	PIN 3
GND	3	PIN 5

8.4.4) MODEM CONNECTION



Signal		EMA 14	modem DB25	modem DB9
TX	Transmit Data	1	2	3
RX	Receive Data	2	3	2
Ground	Signal GrouND	3	7	5

To make the remote connection it needs to program the remote modem (connected to the EMA network). To program this modem the user has to use any communication program like HyperTerminal. The Hayes commands to program a standard modem are the following:

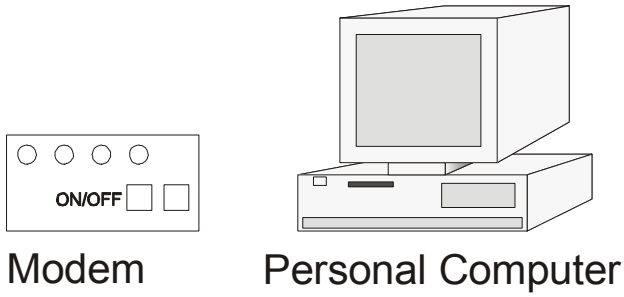
AT&D0&S0&C0&R1
ATS0=2
ATX3
AT&W0Y0

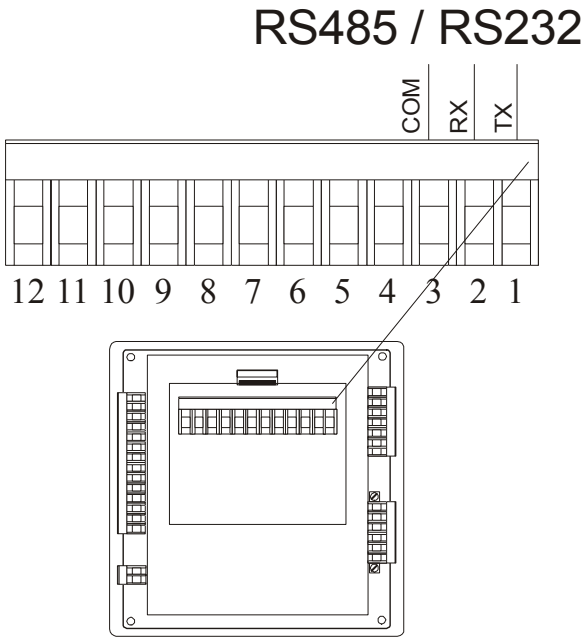
The meaning of the commands is the following (AT is the command prefix):

- &D0: ignore DTR.
- &S0: ignore DSR.
- &C0: ignore CD.
- &R1: ignore RTS.
- S0=2: set at two as the ring number after the which the modem automatically reply (the number can be different by 2, but it must be different by 0).
- &W0: store the configuration in the register 0 of the modem's not volatile memory.
- Y0: set the configuration stored in the register 0 of the modem's not volatile memory as the default configuration at the starting or the reset of modem.

See the modem's user manual.

8.4.5) OPTION RS485/RS232 COM2 (“PLUG-IN”)





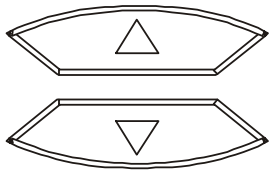
Warning. The hardware modification of instrument will change the Setup in the default configuration.

9) USE

9.1) FUNCTION KEYS

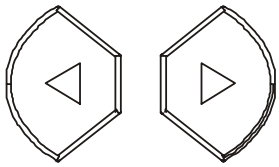
- **UP & DOWN KEYS**

The “UP” and “DOWN” keys allows to skip through the real time pages and to select the programming level or to modify values during the input in the setup menu.



- **LEFT & RIGHT KEYS**

The “LEFT” and “RIGHT” keys allow to change the selected digit during a programming. To skip from real time pages and to go in the menu setup it’s necessary to press simultaneously both these keys. To come back at real time pages to repeat the same operation.

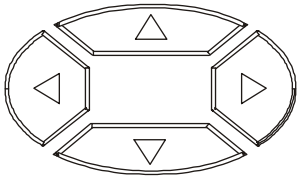


- **“ENTER” KEY**

“ENTER” key, if pressed for at least 3 seconds on any of the real time pages (instantaneous value pages) sets the current visualized page as “MAIN PAGE”.
In the SETUP menu the “ENTER” key allows to enter in the setting menu to program and/or to set values and confirm the operation/s.

- **SYSTEM RESET**

To reset the unit directly from the keyboard without entering in the Setup menu (where from there it is also possible to reset the unit through Reset Global on chapter 11.8), operator may press simultaneously the 4 arrow keys, after 2 seconds the complete unit will be re-set.



10) REAL TIME VALUES

The real time pages show all the possible performed measurement of the instrument during the evolution. All visualized pages may be set as main page by the operator, this means that the preferred page may be set as the one to be visualized. To set the main page the operator shall press the "ENTER" key for at least 2 seconds until on display will not compare the page showed beside. The main page compare at the starting and 30 second after the visualization of another page.

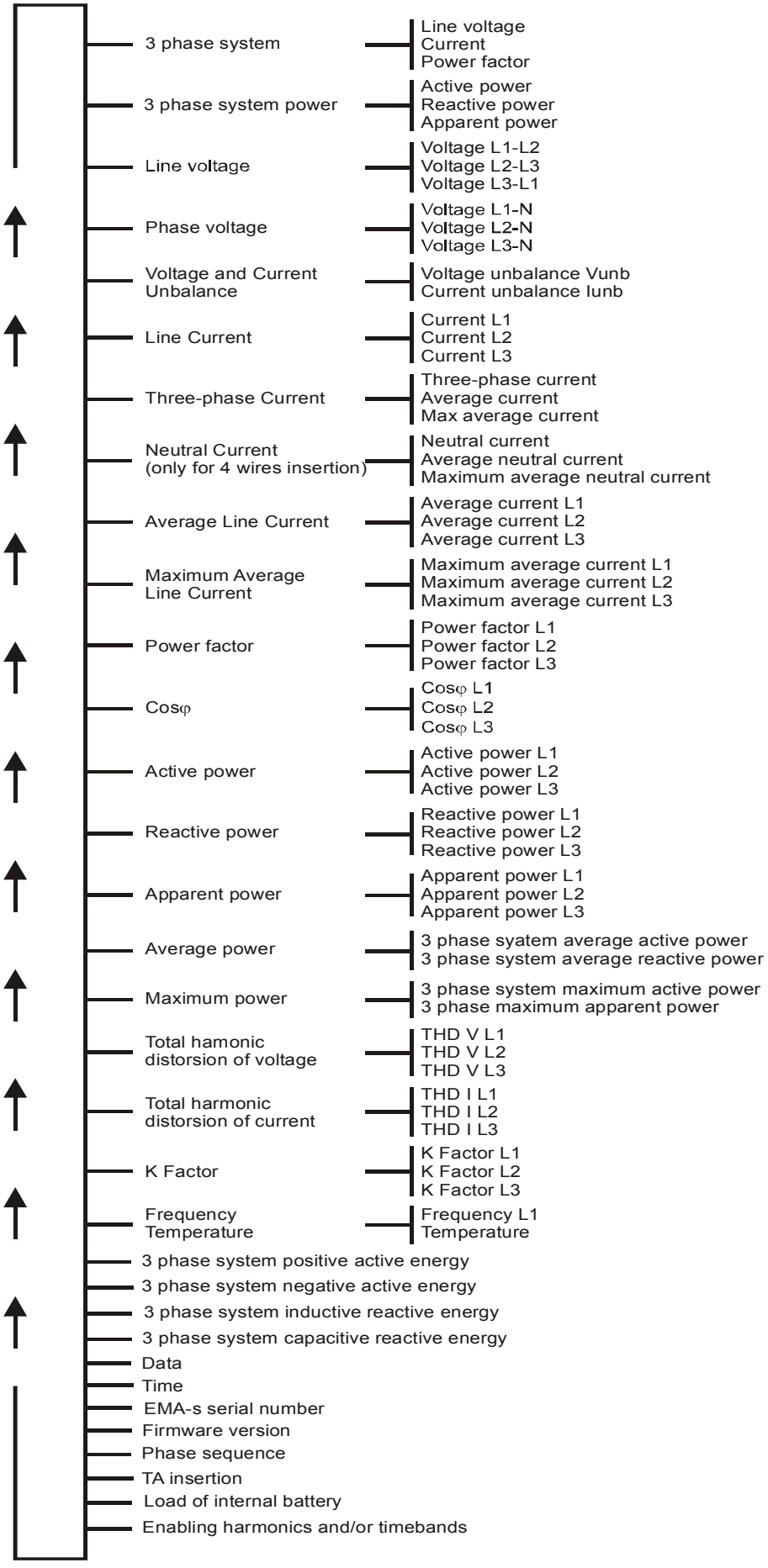
Note: The display usually shows the measure.

Pressing 

the display will show the unit of measurement of the values displayed.

The visualization of real time measure is a sequence of pages, that it’s possible to see pressing “UP and “DOWN” keys.

10.1) VISUALIZATION TREE



10.2) MEASURES VISUALIZATION

All the time that the pages change the display shows the variables measured and after about 2 seconds on display appears the real time values. To see another time the name of page to press the Enter key.

Variable reading of three - phase system

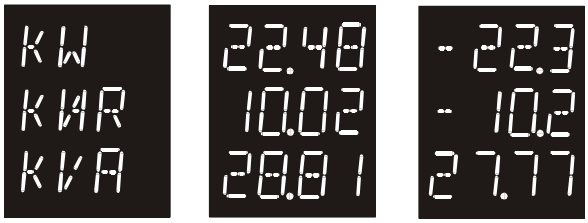
- (V - kV) RMS three - phase system voltage [$\sum V_{L-L}$]
- (A - kA) RMS three - phase system current [$\sum I$]
- (PF) three - phase system power factor [$\sum PF$]

Note:
If the load is capacitive, the first digit of PF visualization will be the minus sign (-).

Variable reading of three- phase system power

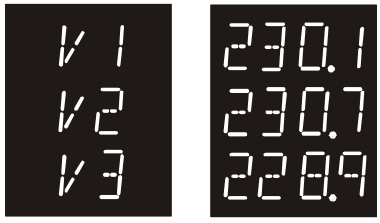
- (W - kV - MW - GW) three - phase system active power [$\sum P$]
- (VAr - kVAr - MVAr - GVAr) three - phase system reactive power [$\sum Q$]
- (VA - kVA - MVA - GVA) three - phase system apparent power [$\sum S$]

Note: If the active power is negative, the first digit of its visualization will be the minus sign (-). If the reactive power is capacitive, the first digit of its visualization will be the minus sign(-).



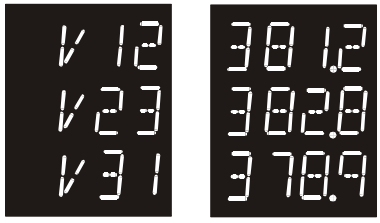
Variable reading of line voltage

(V - kV) rms voltage L1 [V_1]
(V - kV) rms voltage L2 [V_2]
(V - kV) rms voltage L3 [V_3]



Variable reading of phase voltage

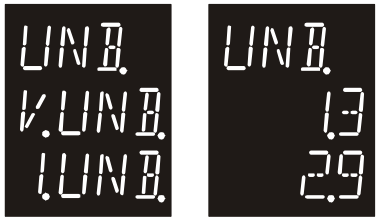
- (V - kV) rms voltage between L1 and L2 [V_{1-2}]
- (V - kV) rms voltage between L2 and L3 [V_{2-3}]
- (V - kV) rms voltage between L3 and L1 [V_{3-1}]



Variable reading of line or phase voltage unbalance and line current unbalance

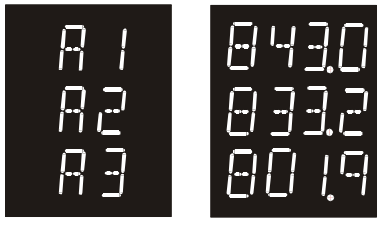
- percentage of line or voltage unbalance [V_{unb}]
- percentage of current unbalance [I_{unb}]

Note: only one of the voltage unbalance defined in setup is displayed.

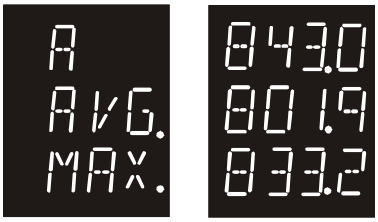


Variable reading of line current

- (A - kA) rms current L1 [I_1]
- (A - kA) rms current L2 [I_2]
- (A - kA) rms current L3 [I_3]

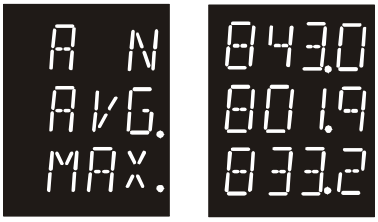


Variable reading of three-phase current
- (A - kA) rms three - phase system current [ΣI]
- (A - kA) rms average three - phase system current [Σ I_{av}]
- (A - kA) rms maximum average three - phase system current [Σ I_{maxav}]

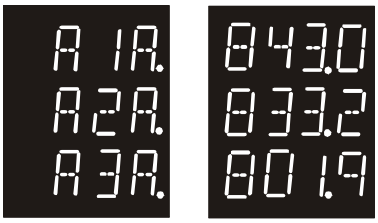


Variable reading of neutral current
- (A - kA) neutral current [I_n]
- (A - kA) average neutral current [I_n]
- (A - kA) maximum average neutral current [I_n]

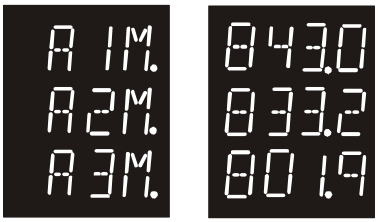
Note: This page compare only the set insertion is 4 wires (see par. 6.4).



Variable reading of average line current
- (A - kA) rms average current L1 [I_1]
- (A - kA) rms average current L2 [I_2]
- (A - kA) rms average current L3 [I_3]

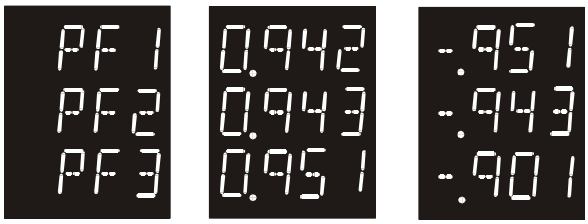


Variable reading of maximum average line current
- (A - kA) rms maximum average current L1 [I_1]
- (A - kA) rms maximum average current L2 [I_2]
- (A - kA) rms maximum average current L3 [I_3]



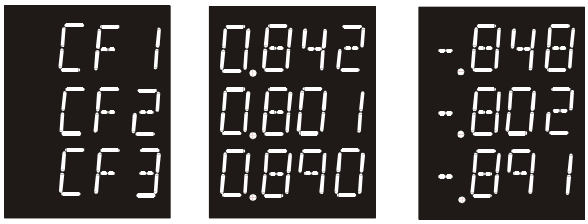
Variable reading of line power factor
- (P.F.) power factor L1 [PF_1]
- (P.F.) power factor L2 [PF_2]
- (P.F.) power factor L3 [PF_3]

Note: If the power factor is capacitive, the first digit of its visualization will be the minus sign (-).



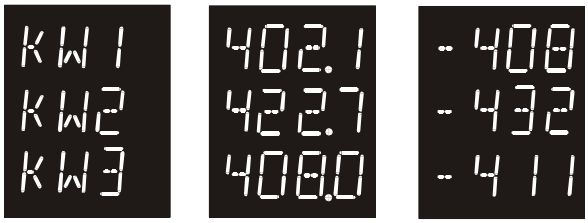
Variable reading of line cosφ
- (cosφ) cosφ fase L1 [$\cos\varphi_1$]
- (cosφ) cosφ fase L2 [$\cos\varphi_2$]
- (cosφ) cosφ fase L3 [$\cos\varphi_3$]

Note: If the cosφ is capacitive, the first digit of its visualization will be the minus sign (-).



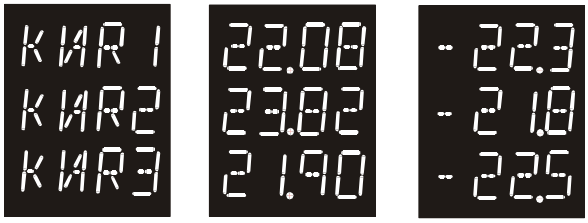
Variable reading of line active power
- (W - kW - MW - GW) active power L1 [P_1]
- (W - kW - MW - GW) active power L2 [P_2]
- (W - kW - MW - GW) active power L3 [P_3]

Note: If the active power is negative, the first digit of its visualization will be the minus sign (-).

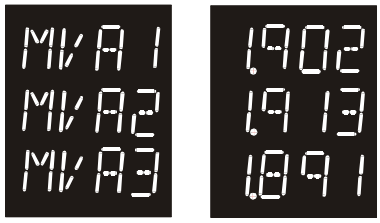


Variable reading of line reactive power
- (VAr - kVAr - MVAr - GVAr) reactive power L1 [Q_1]
- (VAr - kVAr - MVAr - GVAr) reactive power L2 [Q_2]
- (VAr - kVAr - MVAr - GVAr) reactive power L3 [Q_3]

Note: If the reactive power is capacitive, the first digit of its visualization will be the minus sign (-).

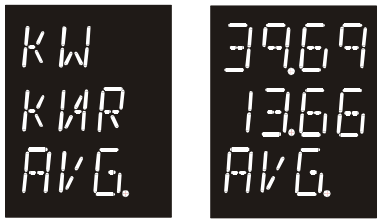


Variable reading of line apparent power
- (VA - kVA - MVA - GVA) apparent power L1 [S_1]
- (VA - kVA - MVA - GVA) apparent power L2 [S_2]
- (VA - kVA - MVA - GVA) apparent power L3 [S_3]



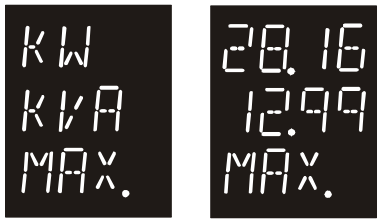
Variable reading of three - phase system average power
- (W - kW - MW - GW) average active power [$\sum P_{AV}$]
- (VAr - kVAr - MVAr - GVAr) average reactive power [$\sum Q_{AV}$]

Note: The average power is calculated in average time [T.AVG] set in setup menu.



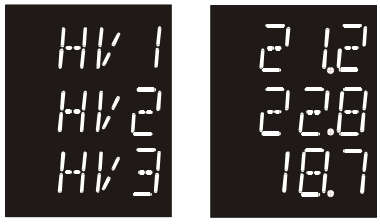
Variable reading of three - phase system maximum power
- (W - kW - MW - GW) maximum active power [$\sum P_{max}$]
- (VA - kVA - MVA - GVA) maximum apparent power [$\sum S_{max}$]

Note: The maximum value is only link at the positive active power.



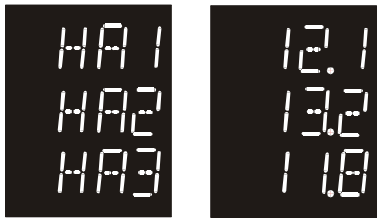
Variable reading total harmonic distortion of voltage
- (%) percentage value of voltage phase L1 distortion index [%V_1]
- (%) percentage value of voltage phase L2 distortion index [%V_2]
- (%) percentage value of voltage phase L3 distortion index [%V_3]

Note: This function is enabled only of the instrument type H.
To see harmonic components up to 31st order, it's necessary to use NRG software or the relative serial commands.

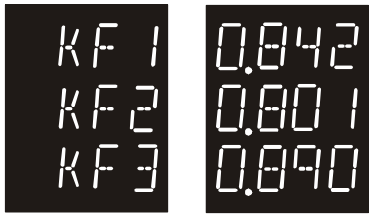


Variable reading total harmonic distortion of current
- (%) percentage value of current phase L1 distortion index [%I_1]
- (%) percentage value of current phase L2 distortion index [%I_2]
- (%) percentage value of current phase L3 distortion index [%I_3]

Note: This function is enabled only of the instrument type H.
To see harmonic components up to 31st order, it's necessary to use NRG software or the relative serial commands.

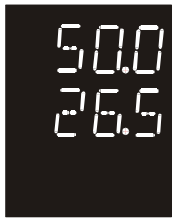


Variable reading K factor of phase
- K factor phase L1 [KF_1]
- K factor phase L2 [KF_2]
- K factor phase L3 [KF_3]

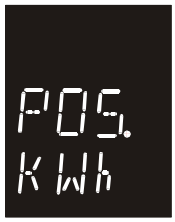


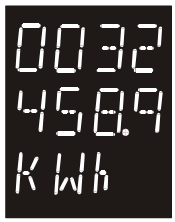
Variable reading frequency and temperature
- (Hz) Frequency L1 [F_1]
- (°C) Temperature [T]

Note: The temperature sensor is inside the instrument and it measures the temperature near the instrument.



Variable reading consumption of acquired active energy
- (kWh - MWh) active positive energy counter [Wh+]

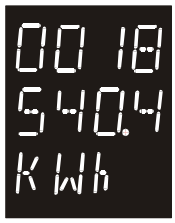




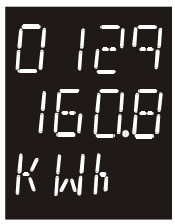
Note: the energy counter is compound of 8 digit, 4 on the first line and 4 on the second. Example:

Reading 0018 540.4 = 18540,4 Kwh

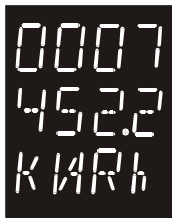
The other counters function in the some way.



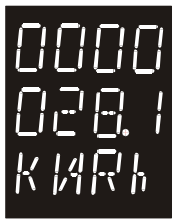
Variable reading consumption of transferred active energy
- (kWh - MWh) negative active energy counter [Wh-]



Variable reading consumption of inductive reactive energy
- (kVArh - MVArh) inductive reactive energy counter [VArh+]



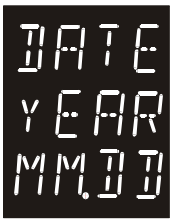
Variable reading consumption of capacitive reactive energy
- (kVArh - MVArh) capacitive reactive energy counter [VArh-]

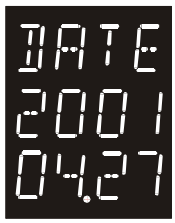


10.3) STATUS AND INFORMATION PAGES

Reading date
- Visualization of date of today: YYYY-MM-DD (year - month - day).

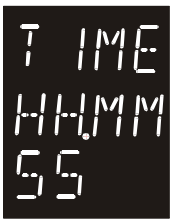
Note: The first time it's necessary to input the date, afterwards the date will be updated by internal clock.

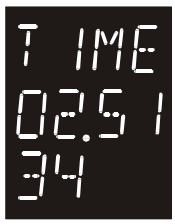




Reading time
- Visualization of the present time: HH-MM-SS (hour - minutes - seconds).

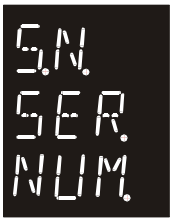
Note: The first time it's necessary to input the time, afterwards the time will be updated by internal clock.

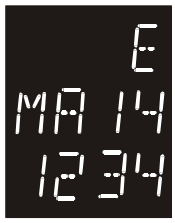




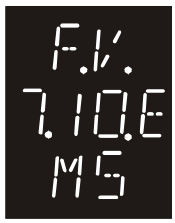
Reading serial number
- Visualization of the serial number of the instrument.

Note:
The serial number identifies the instrument and it will be the same of the label on the instrument.



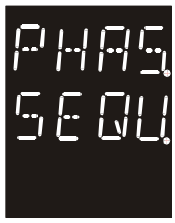


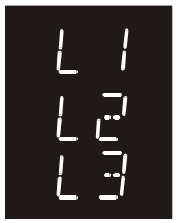
Reading firmware version
- Visualization of the firmware version of the instrument.

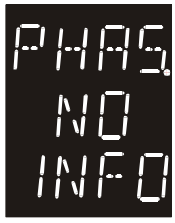


Reading phase sequence
- Visualization of the voltage phase sequence

If the sequence of voltage phase is ok, on display will compare ***L1 L2 L3***, at contrary ***L1 L3 L2***.
If the voltage phase are not connected or the input voltage is lower of 10V or during this calculation on display will compare ***PHAS. NO INFO***.



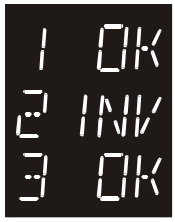


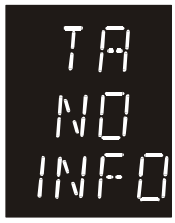


Note: This page appears automatically if the instrument notices an inversion phase but only if the warning is enabled (in the setup menu Yes). If the inversion remains, on display will appear this page alternatively at the default page.

Reading insertion current transformer
- Visualization of the status of current transformer.

If the connection of the TA is ok on display will appear ***1 OK - 2 OK - 3 OK***, at contrary the inversion phase will be indicated (example 1 OK - 2 INV - 3 OK).
If current inputs are opened or during this calculation on display will appear ***TA NO INFO***.

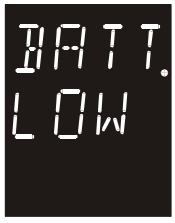




Note: This page appears automatically if the instrument notices an inversion phase but only if the warning is enabled (in the setup menu Yes). If the inversion remain on display will appear this page alternatively at the default page.

Reading charge of the battery
- Visualization the charge of battery.

If the voltage level of internal battery is lower of 2.3V on display will appear “Batt. LOW”, otherwise “Battery OK”.

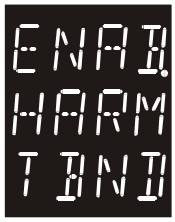


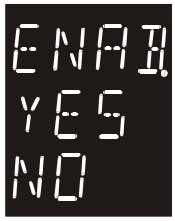
The internal battery needs to hold the setup and all storing data. If you remove it or its charge is lower of the 2.3V and the instruments off it’s possible to lose all storing data.

Note: This page will be displayed independently of the Warnings when the voltage level is lower of 2.3V.

Reading state of harmonics and time-bands
- Visualization state of harmonics and/or time-bands.

If it’s the H instrument both harmonics and time-band are enabled the display shows ***YES***.
If it’s the L instrument both harmonics and time-band are disabled the display shows ***NO***.





Note: It’s possible to enable harmonics or time-bands after the purchase. To make this it’s necessary to give the serial number and the option(s) to enable at Contrel Elettronica Srl that will send the access code corresponding at the instrument and the option(s) selected to input at the voice CODE in the setup.

11) SETUP

The pages of the setup are:

- 3 Ph Meas (type of current insertion) [4 wires - 3 wires - Aron]
- Warnings (enable automatic warnings) [No - Yes]
- VTP. (primary voltage transformer) [1÷400000]
- VTS. (secondary voltage transformer [1÷750]
- CTP. (primary current transformer) [1÷5000]
- CTS. (secondary current transformer) [1-5]
- Meas. TIME (filter time for measure visualization) [0÷50]
- D. PAG. TIMEe (time of default page visualization) [10÷900]
- T. AVG. (integration time) [1 - 2 - 3 - 5 - 6 - 10 - 12 - 15 - 20 - 30 - 60]
- AVG. TYPE (type of window in average calculation) [fixed-mobilel]
- DT MOB. (Sliding time of window mobile) [10" - 20" - 30" - 1' - 2' - 3' - 5' - 6' - 10' - 12' - 15' - 20' - 30' - 60']
- SYNC. TYPE (sincronization frequency) [internal-external]
- SYNC. FREQ.(value of the sincronization frequency) [005.0÷500.0]
- V. UNB. (Unbalance voltage) [V_{L-N} - V_{L-L}]
- NRG TYPE (KW o MW) [Normal - Heavy]
- DATE (data of today: YYYY-MM-DD) [1998-01-01 ÷ 2234-12-31]
- TIME (present time: HH-MM-SS)
- PROTOCOL (ASCII - Modbus)
- COM 1 (serial output 1)
  - Baud rate [1200 - 2400 - 4800 - 9600 ÷19.200]
  - Data Bit (ASCII [7-8]) (Modbus [8])
  - Parity [E-O-N]
- COM 1 TYPE (type of serial) [RS232-RS485]
- COM 2 (serial output 2)
  - Baud rate [1200 - 2400 - 4800 - 9600 ÷19.200]
  - Data Bit (ASCII [7-8]) (Modbus [8])
  - Parity [E-O-N]
- COM 2 TYPE (type of serial) [RS232-RS485]
- COM Node (logic address of the instrument) [01÷128 ASCII - 01÷256 Modbus]
- DO1 VAR (variable of digital output 1) [128÷257]
- DO1 MODE [Off - Puls - Min - Max - Band - On]
- DO1 (Value of contro)l [0000000.0÷99999999]
- DO1 TIME (Delay/Pulse) [000÷999]
- DO1 HYST. (Percentage hysteresis) [00÷99]
- DO2 VAR (variable of digital output 2) [128÷257]
- DO2 MODE [Off - Puls - Min - Max - Band - On]
- DO2 (Value of contro)l [0000000.0÷99999999]
- DO2 TIME (Delay/Pulse) [000÷999]
- DO2 HYST. (Percentage hysteresis) [00÷99]
- *
- Inp. Mode (data of digital input) [Off - Sync.- Band]
- **
- KWh+ (Preset positive active energy counter) [0000000.0÷9999999.9]
- KWh- (Preset negative active energy counter) [0000000.0÷9999999.9][]
- KVArhI (Preset inductive reactive energy counter) [0000000.0÷9999999.9]
- KVArhC (Preset capacitive reactive energy counter) [0000000.0÷9999999.9]
- CODE (Code to enable harmonics and/or timebands) [000000÷999999]
- PASSWORD (Code to access tol setup) [0000÷9999]
- RES. MAX. (Reset maximum and minimum values) [No -Yes]
- RES. ENER. (Reset energy counters) [No -Yes]
- RES. SET. (Reset setup) [No -Yes]
- RES. UNIT (Total reset) [No -Yes]

*DO3-DO4 pages with 2DI+2DO option
DO3÷DO6 pages with 4DO option

**AO1-AO2 pages with 2AO option
AO1÷AO4 pages with 4AO option

**AO1Pages

AO1 MODE (signal type of Analog Output 1) [Off - 0÷20 - 4÷20]

AO1 VAR (variable of analog output 1) [128÷257]

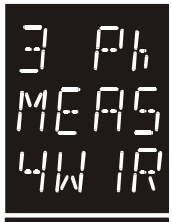
MIN (Minimum value) [0000000.0÷9999999.9]

MAX (Maximum value) [0000000.0÷9999999.9]

To remember to confirm the input/output or the programming with the enter key. The last modify will be stored in the memory up to the next reset.

If the memory is uncharged or it is removed and the instrument is off the storing data will be lost.

11.1) MAIN MENU SETUP



The page ***3 Ph Meas*** allows to set the type of current insertion at the instrument in the way that the instrument can calculate the neutral current (***4WIR***) or the third current (***ARON***). Selecting ***3WIR*** and ***ARON*** the neutral current page will not displayed.

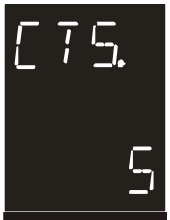
The ***Warnings*** page allows to set (with ***YES***) the automatic visualization of sequence phase or TA inversion when one or both the conditions happened. In this case the relative page will be displayed in alternative of default page till when the cause does not disappear. Setting ***NO***, to verify the phase sequence or the TA inversion it's necessary to see the relative pages, using "UP" and "DOWN" keys. The page of status of battery will be displayed independently from this setting but when the level of charge is lower of 2.3V, in the way to change it immediately.

VTP. allows to set the primary voltage transformer value, if the VT is used, to display the primary voltage. Range: 1÷400000V.

VTS. allows to set the secondary voltage transformer value, if the VT is used, to display the primary voltage. Range: 1÷750V.

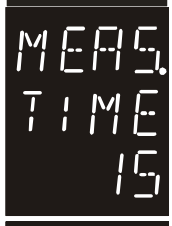
Ex. If the VT used is a 20000/100V, it's necessary to set VTP.=20000 and VTS.=100.

CTP. allows to set the primary current transformer, if the CT is used, to display the primary current. Range: 1÷5000A.



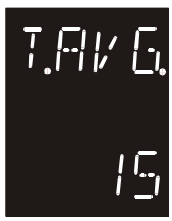
CTS. allows to set the secondary current transformer , if the CT is used, to display the primary current. Range: 1 or 5A (for EMA14-1A is fixed to 1).

Ex. If the CT used is a 200/1, it's necessary to set CTP.=200 and CTS.=1.



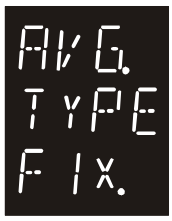
MEAS. TIME: is the filter time in the visualization measure. The range is 0÷50. The 0 value indicates none average on the measures, others values indicates the average time (in seconds).

D.PAG. TIME: is the time of wait before to come back to default page. Range 10÷900 seconds.

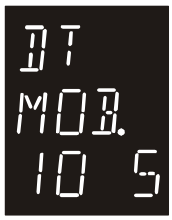


T.AVG: is the integration time (expressed in minutes) for calculating the average values (es. average power).

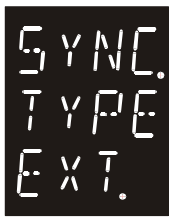
AVG. TYPE: defines the type of the window used to the average calculation: fixed (the updating depends of the Average time) or mobile (the updating depends of dt Mobile).



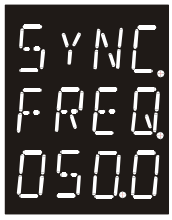
DT MOB.: defines the updating time in window mobile of the average parameters.



SYNC. TYPE: is the definition of the synchronization of fundamental frequency.
Type: external (EXT) or internal (INT).

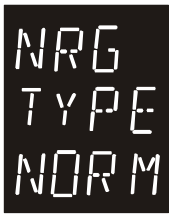


SYNC. FREQ.: is the definition of the synchronization of fundamental frequency.

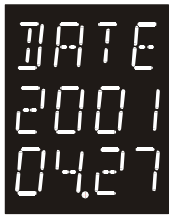


V.UNB.: allows to calculate the voltage unbalance between the line voltage (VLL) or phase voltage (VLN).

NRG TYPE: to set the type of energy: normal [NORM] (kW) or heavy [HEAV] (MW).

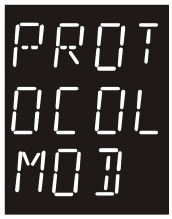


DATE: to program the date of today.
After first programming the date will be updated automatically by internal clock.



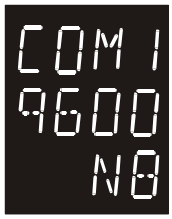
TIME: to program the present time.
After first programming the time will be updated automatically by internal clock.

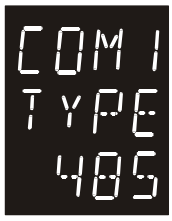
11.2) SERIAL COMM



PROTOCOL: can be chosen between ASCII and MODBUS.

COM1: the serial COM1 page allows to program the communication parameters.
Baud: transmission speed programmable
1200, 2400, 4800, 9600, 19200.
Parity: parity sequence programmable
NONE-EVEN and ODD. [N - E - O]
DataBit: number of data bits, programmable
7 or 8 bit. [7 - 8]
Note:
Default: 9600 baud - parity-N - DataBit 8.





Type: type of serial output to manage, COM1 configurable as RS485 or RS232.

COM2: the serial COM2 page allows to program the communication parameters.
Baud: transmission speed programmable
1200, 2400, 4800, 9600, 19200.
Parity: parity sequence programmable
NONE-EVEN and ODD. [N - E - O]
DataBit: number of data bits, programmable
7 or 8 bit. [7 - 8]
Note: Default: 9600 baud - parity-N - DataBit 8.

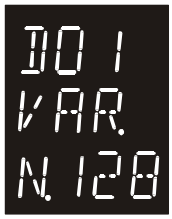
Type: type of serial output to manage, COM1 configurable as RS485 or RS232.

Note: Don't use COM2 port to send the setup from NRG or other communication software. COM2 can be used only to monitor the instrument. COM2 has lower level priority in respect to COM1.

Node: logic addresses (1÷128 in ASCII, 01÷255 in MODBUS).
This number identifies the node in a network and consequently the instrument or the peripheral of a serial multidrop network.
This parameter is set freely. This parameter is set automatically using NRG software with ASCII protocol while with MODBUS protocol it must be set manually.

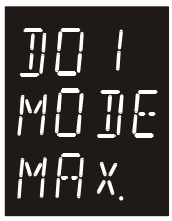
11.3) DIGITAL OUTPUT

The digital outputs can be programmed to function like alarm (overload, load management for consumption optimization, etc.), or pulses emission for energy calculation or remote activation using software NRG.

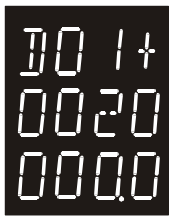


VAR: is the number of measure to associate on the digital output from 128 to 257 (see list of variables on chapter 13).

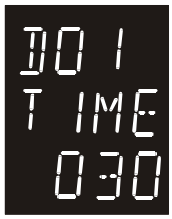
MODE: allows to select the type of functioning as: ”OFF”, “Puls”, “Min.”, “Max.”, “Band”, “ON”.



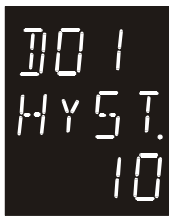
Off digital output is always disabled.
Puls: pulse emission proportional at energy registered and depending the programming used (valid only for Energies).
Min: the output is enabled if the value of the selected variable is lower of the programmed value.
Max: the output is enabled if the value of the selected variable is higher of the programmed value.
Band: the output is enabled if the value of the selected variable is lower of the programmed minimum value or higher of the programmed maximum value.
On: digital output is always enabled.



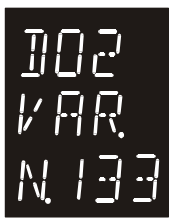
Value: intervention threshold value (i.e., for overcoming 340V program 340.0, or 150kW program 150000,0) or pulse weight (i.e., if the active positive energy pulses must be emitted every 1 kWh program 1.00) programmable from 0,01 to 100 kWh/pulse. If the user selects the ***Band*** will appear before the ***MIN*** page (lower limit) and after the confirmation, with the Enter key, of the value set, the display will show the ***MAX*** page (higher limit). The message ***NO VAL*** will appear if the ***VAR*** set is not a valid value.



TIME: is the threshold delay for intervention expressed in second (0-655 seconds) or duration time of Pulse expressed in milliseconds (50-500 ms).



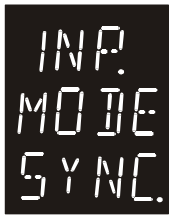
HYST.: it’s the percentage of alarm’s value under which the alarm comes back in off condition: it’s programmable from 0 to 99%.



For the digital output 2 (***DO2***) are available the same parameters:
VAR (variables)
MODE
VALUE
TIME
HYST.
The same parameters, of the **DO1** and **DO2**, are available to program the digital outputs 3, 4, 5 and 6 (**DO3**, **DO4**, **DO5** and **DO6**) to use with the option boards.

11.4) DIGITAL INPUT

The instrument has 2 digital inputs.



INP.MODE: defines the type of operation:
Off: if none input is selected or enabled.
Sync: to synchronize the internal clock with the external instruments.
When the impulse arrives on digital input, the internal clock's seconds counter is cleared if it's between 00 and 29, while if it's between 30 and 59, it's cleared and the minutes counter go on the next minute.
Band: to change the bands for the energy counter in the time bands. The following table shows the time band selected depending of the status of digital inputs:

DIGITAL INPUT 2	DIGITAL INPUT 1	BAND SELECTED
OPEN	OPEN	P1
OPEN	CLOSED	P2
CLOSED	OPEN	P3
CLOSED	CLOSED	P4

CLOSED: there is a voltage from 12Vcc and 24Vcc.
OPEN: the voltage is 0Vcc.

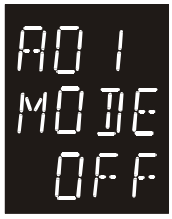
The change of band happens when the instrument recognizes a change of status on one of digital input at least.
At the moment of the digital inputs enabling like "Band" and at the EMA's turn on with the enabling already set, the energy counters increment continue on the last band enabled independently of the digital inputs status until the change of the minute of the internal clock or the change of the status of one of digital input.

Note: only using the software NRG it's possible to program and to read the time bands.

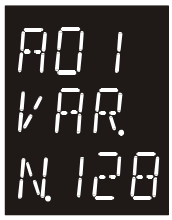
11.5) ANALOG OUTPUT (OPTION)

The analog pages are always presents but only if the hardware is mounted, the function is activated.

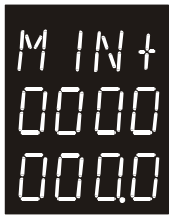
MODE
Off**:** output disabled.
0-20: output enabled, type 0-20 mA.
4-20: output enabled, type 4-20 mA.



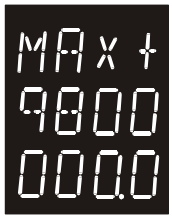
VAR: is the number of measure to associate (from 128 to 257, expressed in decimals) at the analog output (see list of variables on the chapter 13).



MIN: full-scale value of the lower limit of the programmed value (VAR).
Once the minimum full-scale has been programmed, the instrument automatically will associate the minimum current value (0 or 4 mA) at this value. The message ***NO VAL*** will appear if the ***VAR*** set is not a valid value.

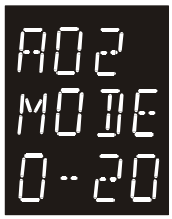


MAX: full-scale value of the upper limit of the programmed value (VAR).
Once the maximum full-scale has been programmed, the instrument automatically will associate the maximum current value (20 mA) at this value. The message ***NO VAL*** will appear if the ***VAR*** set is not a valid value.

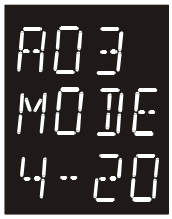


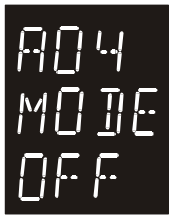
If the minimum end-scale value is lower of maximum end-scale value, the out of current will be directly proportional at variable set, otherwise it will be inversely proportional. Minimum and maximum can be negative value.

To program the analog output 2 (***AO2***) are available the same parameters of the first output (AO1):
VAR.
MIN
MAX



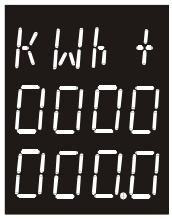
The same parameters, of the AO1, are available to program the analog outputs 3 and 4 (***AO3*** and ***AO4***) to use with the option boards:
VAR.
MIN
MAX



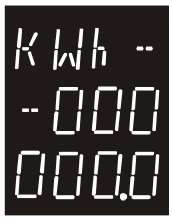


11.6) PRESET ENERGY COUNTERS

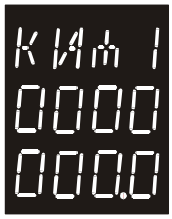
It's possible to set energy counters at initial value. This function is useful for example to compare the consumption with an energy counter already in use. The time bands counters don't consider the preset values. Only total energy counters consider these values.
It's possible to set the following counter:



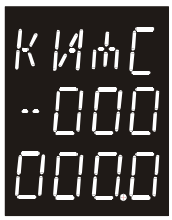
Preset positive active energy counter.



Preset negative active energy counter.

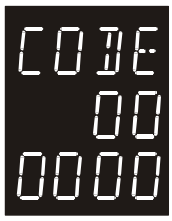


Preset Inductive reactive energy counter.

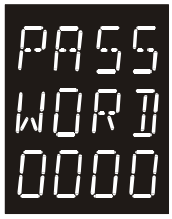


Preset capacitive reactive energy counter.

11.7) CODE AND PASSWORD



CODE: allows to input a code of 6 digits to enable the calculation end the visualization of the harmonics and/or the time-bands. These options are both enabled if it's an H instrument: the code is on a report. These options are disabled if it's an L instrument but one or both can be enabled. To make this it's necessary to give the serial number and the option(s) to enable at Contrel Elettronica Srl that will send the access code corresponding at the instrument and the option(s) selected.



PASSWORD: it's possible to set a numeric password to modify the setup.
The default password is 0000. In this condition the setup can be always opened and it's always possible to change any parameter. If the password is different by 0000 (from 0001 to 9999), at the entrance of setup, the password will be request. It will be always possible to see every parameter but it will be impossible to modify everything if the password is ignored. Only to input the correct password it's possible to change every parameter. To set the new password as 0000, the instrument come back to work at default status.
Call the constructor to have an emergency password if you lose or forget the password.

11.8) RESET

The Reset page allows to cancel some operation or the complete operation of the setup system, reset modes are classified in four groups.

Reset Max: to reset all the minimums and maximums.

Reset Ener.: to reset the energy counters.

Reset Setup: delete all definition in the setup and the instrument come back to default setup.

Reset Global reset complete of the instrument (Setup, measures stored, RAM).

After one minute of keyboard inactivity the instrument comes out of the setup automatically independently of the page visualized except when the field of modify is operating

12) Function and measures available only by serial port with software NRG

TIMEBANDS: energy counters in time bands.
It's possible to program 15 periods programmable on 4 bands. (P1, P2, P3, P4). It's possible to program the start and the stop for each period, the days of the week and the holiday to display the active energy counters (positive and negative) and the reactive energy counters (inductive and capacitive) in 10 groups: today, yesterday, two days ago, this month, previous month, two month ago, this year, previous year, two years ago and total counters of band.

ANALYSIS OF THE HARMONICS COMPONENTS OF VOLTAGE AND CURRENT
Measure with the possibility of storage and alarms of harmonics components of voltage and current up to 31st order with fundamental at 50-60Hz. Visualization of each phase in numeric or graphic form.

VISUALIZZATION MAXIMUM AND MINUMUM VALUES
Possibility to display the minimum and the maximum value of 12 parameters and the date and the time in which the storage is happened. If the storage in ram is disabled, the minimum and the maximum displayed are absolute, otherwise it's relative at the sampling period set.

DATA STORAGE
Programming and downloading of measures including the storage in the time of maximum and minimum samples, average power, harmonics components and samples.

The storage is organized as FIFO (first in first out) type memory. When the memory is full older data will be overwritten by new data. The data downloaded on PC using NRG software or communication protocol does not come deleted and for this reason it's possible to recover them using the function of communication protocol.

All data stored in each archives will be deleted if there is a modify of the storage setup.

Visualization state of RAM archives: enabled or disabled, number of records, memory free and memory used.
Visualization state of digital inputs and digital outputs.

Programming up to 4 analog output (0÷20 / 4÷20mA).
Programming up to 6 digital outputs (alarm, pulse, etc.).
Programming up to 4 digital inputs (sinc., band, etc.).
Programming serial comm optional (RS485).

13) VARIABLES (measure codes)

To program the variables in setup for:

- digital outputs (alarm and pulse)
- analog outputs

it's necessary to use these codes:

CODE	***VARIABLE***
128	THREE-PHASE SYSTEM VOLTAGE (rms)
129	PHASE L1 VOLTAGE (rms)
130	PHASE L2 VOLTAGE (rms)
131	PHASE L3 VOLTAGE (rms)
132	PHASE L1-L2 VOLTAGE (rms)
133	PHASE L2-L3 VOLTAGE (rms)
134	PHASE L3-L1 VOLTAGE (rms)
136	THREE-PHASE SYSTEM CURRENT (rms)
137	LINE L1 CURRENT (rms)
138	LINE L2 CURRENT (rms)
139	LINE L3 CURRENT (rms)
140	THD I_{L1} (Total Harmonic Distortion %)
141	THD I_{L2} (Total Harmonic Distortion %)
142	THD I_{L3} (Total Harmonic Distortion %)
144	THREE-PHASE SYSTEM POWER FACTOR
145	PHASE L1 POWER FACTOR
146	PHASE L2 POWER FACTOR
147	PHASE L3 POWER FACTOR
148	THREE-PHASE SYSTEM $COS\varphi$
149	PHASE L1 $COS\varphi$
150	PHASE L2 $COS\varphi$
151	PHASE L3 $COS\varphi$
152	THREE-PHASE SYSTEM APPARENT POWER
153	PHASE L1 APPARENT POWER
154	PHASE L2 APPARENT POWER
155	PHASE L3 APPARENT POWER
160	THREE-PHASE SYSTEM ACTIVE POWER
161	PHASE L1 ACTIVE POWER
162	PHASE L2 ACTIVE POWER
163	PHASE L3 ACTIVE POWER
168	THREE-PHASE SYSTEM REACTIVE POWER

169 PHASE L1 REACTIVE POWER
170 PHASE L2 REACTIVE POWER
171 PHASE L3 REACTIVE POWER

176 THREE-PHASE SYSTEM ACTIVE ENERGY (acquired)
177 THREE-PHASE SYSTEM REACTIVE ENERGY (inductive)
178 THREE-PHASE SYSTEM ACTIVE ENERGY (transferred)
179 THREE-PHASE SYSTEM REACTIVE ENERGY (capacitive)

180 FREQUENCY

182 THD V_{L1} (Total Harmonic Distortion %)
183 THD V_{L2} (Total Harmonic Distortion %)
184 THD V_{L3} (Total Harmonic Distortion %)

185 AVERAGE THREE-PHASE SYSTEM ACTIVE POWER

186 AVERAGE THREE -PHASE SYSTEM CURRENT

187 AVERAGE THREE-PHASE REACTIVE POWER

188 INTERNAL TEMPERATURE

189 AVERAGE L1 PHASE CURRENT
190 AVERAGE L2 PHASE CURRENT
191 AVERAGE L3 PHASE CURRENT

193 AVERAGE NEUTRAL CURRENT

194 VOLTAGE UNBALANCE
195 CURRENT UNBALANCE

196 K FACTOR L1 PHASE
197 K FACTOR L2 PHASE
198 K FACTOR L3 PHASE

14) PROBLEMS AND SOLUTIONS

If you have a problem setting up or using your instrument, you may be able to solve it yourself.
Before calling your retailer or nearest distributor you should try the suggested actions that are appropriate to your problem.

Problem	Possible cause	Suggested
The instrument doesn't turn on.	- The power supply is disconnected or wrong. - The internal fuse is interrupted.	- Verify the connection and the presence of power supply. - See the chap. cap. 6.1) to verify and/or to change the internal fuse.
The instrument doesn't communicate with the NRG software (or other communication software).	- Communication wires. - Communication protocol. - Wiring system and communication parameters.	- Verify the correct wiring. - Verify that the communication protocol of the instrument coincides with the one used in the sw. - Verify the wiring type (RS232 or RS485) and the settings of the serial port of the instrument.
The instrument communicates with the PC but the communication is interrupted.	- Not shielded wires. - Lack of terminations.	- Use shielded wires. - Connect terminations as par. 8.4.1) and 8.4.2).
The instrument loses the CODE or the PASSWORD.	- E^2prom lost data.	- to try again to input another time the data lost.

If the problem have not been solved, or for other information not covered in the present manual, please contact with our Technical Assistance Department.
Before contacting, it is suggested to collect the maximum information regarding the installation, and mainly the following data:

1. Model and serial number from the label on the top of the instrument housing.
2. Purchase receipt.
3. Description of problem.
4. System configuration (hardware fitted, firmware release etc.).

15) EMA SERIAL COMMUNICATION PROTOCOL

The Electrical Multifunction Analyzer EMA series are disposal with two different communication protocols:

- ASCII standard Contrel
- MODBUS-RTU

and two optionals:

- PROFIBUS with external module
- TCP/IP Ethernet with external module

The standard communication protocol has been optimised for the connection of the analysers with the NRG management software, allowing to use all the available functions (automatic search of the unit in the network, automatic data downloading, etc.).
Even so the NRG software supports the MODBUS protocol.

About all the information of protocols communication to see specific user manual (EMA SERIAL COMMUNICATION PROTOCOL).

16) Notes

contrel elettronica srl
I-26900 Lodi - ITALY - Via S. Fereolo, 9
Tel. +39 0371 30207 / 30761 Fax +39 0371 32819
http://www.contrel.it - E-mail: contrel@contrel.it